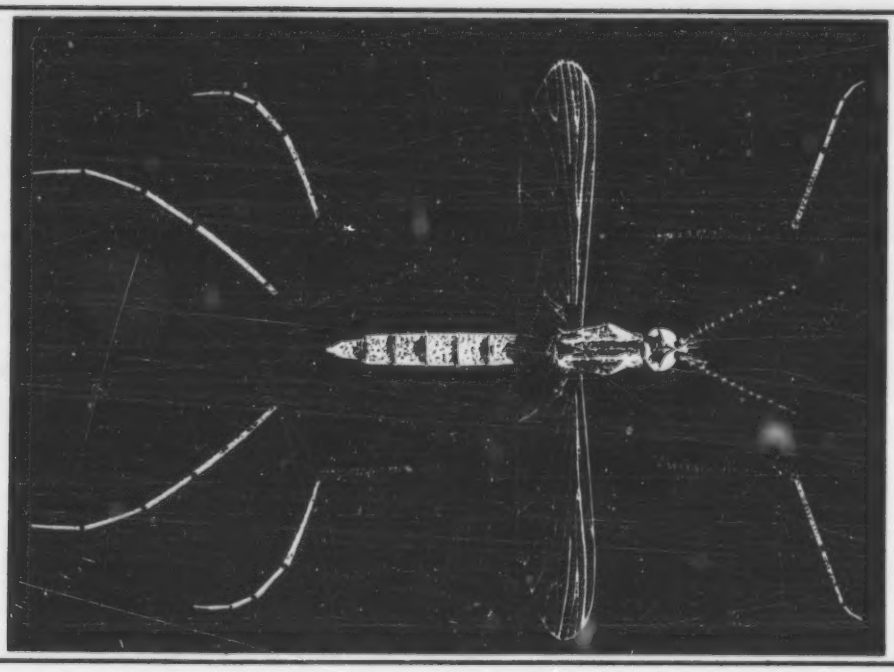
B.C.
Gov't. Pubs -

LEGISLATIVE LIBRARY
WITHDRAWN

THE MOSQUITOES of British Columbia

by L. COLIN CURTIS



The floodwater mosquito, Aedes vexans.

Occasional Papers of the
British Columbia Provincial Museum
No. 15

VICTORIA, B.C. MARCH, 1967

101-03507/

OCCASIONAL PAPERS

of the

British Columbia Provincial Museum

No. 15

THE MOSQUITOES OF BRITISH COLUMBIA

by

L. COLIN CURTIS

Canada Department of Agriculture

Entomological Laboratory, Kamloops, B. C.

Issued March, 1967

Victoria, B. C.

Province of British Columbia
Department of Recreation and Conservation

Hon. W. K. Kiernan,
Minister

D. B. Turner
Deputy Minister

PREFACE

British Columbia has a large and varied mosquito fauna, as might be expected from its diversified terrain. Within its boundaries the mosquito pest ranges from a tolerable nuisance to a problem of monumental proportions, and many communities engage in activities aimed at obtaining some measure of control. In spite of this widespread activity, the province has at the time of writing no body of full-time culicidologists. This publication is designed to be of some assistance to the general entomologist, pest control operator, or interested layman, who may find himself faced with those problems of mosquito biology or identification whose solution is a prerequisite to any effective campaign of control.

The politicai boundaries of British Columbia encompass such a large area that within them are found elements of a number of distinct groups of species. The fauna of the Lower Mainland is related mainly to the Pacific Coast States; the dry Interior supports a blend of this with that of the Great Plains; while our northern forests form a meeting place for the mosquitoes of Alaska and those of the Canadian sub-arctic. The keys here provided should enable the reader to identify fourth instar larvae or adults of any of these groups. Keys to the male genitalia have not been provided, for reasons explained in the text.

Grateful acknowledgement is due to Mrs. Shoko Nishimura for the many diagrams in the text, and to the Bio-Graphic Unit, Research Branch, Canada Department of Agriculture, for the cover design and other illustrations. The information contained in the work has been drawn from numerous sources in addition to the personal experience of the writer, and these sources are listed in the bibliography. My debt to these many authors is hereby acknowledged.

CONTENTS

	Page
HISTORICAL INTRODUCTION	1
THE ECONOMIC IMPORTANCE OF MOSQUITOES	4
MOSQUITO LIFE HISTORIES	6
ECOLOGICAL GROUPINGS	10
THE PRINCIPLES OF MOSQUITO CONTROL	16
COLLECTING AND PRESERVING METHODS	20
MOSQUITO IDENTIFICATION	24
SPECIES DISCUSSIONS	43
ANOPHELES EARLEI Vargas	43
ANOPHELES FREEBORNI Aitken	43
ANOPHELES OCCIDENTALIS Dyar and Knab	44
ANOPHELES PUNCTIPENNIS (Say)	45
ANOPHELES WALKERI Theobald	45
AEDES ABORIGINIS Dyar	45
AEDES CAMPESTRIS Dyar and Knab	46
AEDES CATAPHYLLA Dyar	47
AEDES CINEREUS Meigen	47
AEDES COMMUNIS (De Geer)	48
AEDES DIANTAEUS H. D. and K	49
AEDES DORSALIS (Meig)	50
AEDES EXCRUCIANS (Walker)	51

CONTENTS (cont'd.)

	Page
AEDES FITCHII (Felt and Young)	52
AEDES FLAVESCENS (Muller)	53
AEDES HENDERSONI Cockerell	53
AEDES HEXADONTUS Dyar	54
AEDES IMPIGER (Walker)	54
AEDES IMPLICATUS Vock	55
AEDES INCREPITUS Dyar	56
AEDES INTRUDENS Dyar	57
AEDES MELANIMON Dyar	58
AEDES NIGRIPES (Zetterstedt)	59
AEDES PIONIPS Dyar	59
AEDES PULLATUS (Coquillet)	60
AEDES PUNCTOR Kirby	61
AEDES PUNCTODES Dyar	62
AEDES RIPARIUS Dyar and Knab	62
AEDES SIERRENSIS Ludlow	63
AEDES SPENCERII (Theobald)	64
AEDES STICTICUS (Meigen)	65
AEDES STIMULANS (Walker)	66
AEDES TRICHURUS (Dyar)	67
AEDES TRISERIATUS (Say)	68

CONTENTS (cont'd.)

	Page
AEDES VEXANS (Meigen)	69
CULEX PEUS Speiser	70
CULEX PIPIENS L.	70
CULEX TARSALIS Coquillet	71
CULEX TERRITANS Walker	72
CULISETA ALASKAENSIS (Ludlow)	73
CULISETA IMPATIENS (Walker)	74
CULISETA INCIDENS (Thomson)	75
CULISETA INORNATA (Williston)	76
CULISETA PARTICEPS (Adams)	76
CULISETA MINNESOTAE Barr	78
CULISETA MORSITANS (Theobald)	78
MANSONIA PERTURBANS (Walker)	79
GLOSSARY	82
BIBLIOGRAPHY	87

PHOTOGRAPHS (1-9 inclusive)

FIGURES (1-49 inclusive)

COVER ILLUSTRATION - Aedes Vexans

* * * * * * * * * * * * * * * *

HISTORICAL INTRODUCTION

In its primitive state British Columbia encompassed vast areas ideally suited for the production of mosquitoes and other biting flies in enormous numbers. In modern times many of these breeding areas, particularly in the neighbourhood of centres of population, have been eliminated or subjected to control procedures. Consequently, most of our urban-dwelling citizens have no conception of the devastating effect of these pests upon travellers and workers in earlier times, or even of the conditions still encountered in the remoter sections of the province. Our earliest travellers, the fur traders, apparently regarded mosquitoes as a normal feature of their surroundings, and considered them unworthy of much comment, but visitors from more sheltered environments expressed themselves pungently upon the topic. (25)

One of the first and most articulate to write of his impressions was J. K. Lord (27), naturalist and transport officer to the British section of the International Boundary Commission a little over a century ago. Lord, who had encountered mosquitoes in the Crimea, the Mississippi Valley, the Prairies, and the Rocky Mountains, wrote:

> "Reader, if you have never been in British Columbia, then, I say, you do not know anything about insect persecution; neither can you form the faintest idea of the terrible suffering foes so seemingly insignificant . . . are capable of inflicting."

He recorded that the Indians of the Sumas Lake region had summer lodges built on piles far out from shore in the shallow waters of that body, whither they retreated to escape the ravages of the pest about the marshy margins of the lake.

About thirty years later, the well-known pioneer missionary, Rev. Thomas Crosby, had frequent occasion to travel about the Fraser Valley, and later wrote as follows: (11)

> "In the Fraser Valley, besides the fleas, we were besieged by myriads of mosquitoes that bred in the swales and sloughs and low marshy places, particularly after high water. They literally swarmed, and in some places rose in clouds as one passed, millions of them.

I noticed on my journeying on horseback that my little pony, otherwise gentle and manageable, would jump and run at times in an unaccountable fashion. At such times the mosquitoes would strike my face and forehead like a storm of hail. Then it occurred to me that the intelligent little beast only ran when passing through the spots where these insects mostly swarmed, and henceforward I let him gallop.

The settlers tell of dogs and calves being killed by the mosquitoes, and one reputable gentleman maintains that he had in his possession at one time a cow whose tail had been so bitten by these venomous beasts that it dropped off."

Photo 1 Aedes vexans On a fence at Mission, B. C.
(Photo by Eric Hearle)

Just before the turn of the century two young Englishmen, J. A. Lees and W. J. Clutterbuck, (26) bent on sport, traversed the Kootenay country from north to south. Here is what they have to say on the subject:

> "People at home read of sandflies, Cingalese leeches, stinging ants, mosquitoes, and the like, and the fashion is to treat all such matters more or less as jokes, and to affect merriment at the idea of getting well bitten by any of them. But the truth is that there is no misery on earth equal to a really bad attack by these demons. We all thought that we had seen mosquitoes before, in Norway, in India, and in the States, but until now we knew nothing - absolutely nothing - of the concentrated essence of torture that they are capable of inflicting when you invade their real home."

Lord was the first man to submit a British Columbia mosquito to an authority for identification, but thereon hangs a tale. The pages of his notebooks were punctuated with the flattened remains of many mosquitoes that were resting on the pages as the covers were closed. These must have represented the dominant floodwater species Aedes sticticus and A. vexans, yet the only kind recorded in the appendix to his book was named Culex pinguis by Dr. Walker of the British Museum. This is now known to be a synonym of Culiseta impatiens (Walker) which is quite rare in British Columbia, and seldom approaches man.

Nothing further was done with British Columbia mosquitoes until the early years of the present century, when J. Fletcher, R. C. Trehearne, and C. G. Hewitt, of the then Dominion Entomological Branch, collected at various times and submitted their specimens to H. G. Dyar of the United States National Museum for identification. Dyar himself visited the Kootenay district in 1904, and published a short paper on his collections there, and on Vancouver Island, which he visited in 1906. (12) In 1919 he collected from Prince George to the coast along the line of the Canadian National Railway, and at White Pass and Bennett, on the way to the Yukon, and in 1920 he visited the Fraser Valley. The results of these journeys were incorporated in a paper on the Mosquitoes of Canada (15).

In the early days of the present century immigration and rural settlement proceeded apace, much of it in the lower Fraser Valley, long noted for its teeming population of mosquitoes. The popular demand for relief became so pressing that the National

Research Council, in co-operation with the Dominion Department of Agriculture, set up a project for the study of the problem, and Mr. Eric Hearle worked in the valley in the summers of 1919, 1920, and 1921. His report (18) served as the basis for control work in the province for many years thereafter. In 1928 Hearle established the Livestock Insects Laboratory at Kamloops, which is still the base from which are conducted studies on insects affecting man and animals.

THE ECONOMIC IMPORTANCE OF MOSQUITOES

It is difficult to estimate the economic loss attributable to the activities of mosquitoes, but in the past this has reached serious proportions. Lord (27) reported that the men of the International Boundary Commission were forced to abandon their base camp beside Sumas Lake and retreat to the hills for the summer months, and in the same area during the summer of 1911 the brickworks at Clayburn had to close for three weeks, the employees leaving the district. (18) During that same summer the construction of the Stave River Dam was greatly impeded, and it was only after the contractors had spent two thousand dollars on headnets and screening that the workers could be persuaded to stay on the job. In the Mission district, noted for its strawberries, there have been years when 35 per cent of the crop has been lost because the pickers could not stay in the fields at the height of the season. Milk and egg yields have on occasion been cut by 50 per cent, and weight gains in beef cattle reduced when the animals could neither feed in peace nor rest. Farmers depending on horses for field work have been unable to use them at the height of the pest, and logging camps have at times had to close down until the mosquito season had passed its peak.

In a country in which tourism is so important to the economy as it is in British Columbia the adverse effect of the mosquito pest around resorts and stopping places cannot be overemphasized. While the visitor may not always appreciate the absence of the pest, he will become intensely aware of its presence, and return visits will be governed accordingly. Outdoor living has become a prominent feature of our culture for visitor and resident alike, and its full enjoyment is impossible unless there is freedom from annoyance.

Mosquitoes and Disease

It is now common knowledge that in many parts of the world mosquitoes are of immense importance as vectors of disease, but this knowledge belongs to the present century. History is full of events whose outcome has been decided, not by armies or navies, not by the planning of generals or the scheming of politicians, but by the ravages of the lowly mosquito. Alexander the Great, while seeking new worlds to conquer, was himself laid low by mosquito-borne malaria, and the fall of both the Grecian and the Roman empires has been laid to the same cause. In more recent times the rapid termination of the 1916 campaign against the Germans in East Africa was due to the fact that the German forces were driven into the valley of the Rugigi River, where malaria made the country untenable and forced their surrender. To quote Sir Ronald Ross - "Malaria is the principal and gigantic ally of barbarism. For centuries the successive waves of civilisation which have flooded and fertilized Europe and America have broken themselves in vain on the deadly shores of Africa."

Whether or not ancient man knew the connection between mosquitoes and disease, it appears that he took steps to protect himself from annoyance. It is recorded that when a Roman army reached Canopus on the Nile, the soldiers found that the inhabitants were accustomed to sleep under protective nets. They adopted the idea, and thereafter many a legionary included in his kit a "canopaeum" to ensure quiet repose. Thus is derived our word "canopy."

In tropical America the first place for mosquito-borne disease is taken by yellow fever, the plague that beset Drake's marauding crews and wrecked DeLesseps' plans for a Panama canal. But the world-wide champion in the ranks of pestilence is without doubt malaria. It is only a score of years ago that the United States Public Health Service estimated the annual economic loss in that country from malaria at a hundred million dollars. Since that time, with the aid of DDT, malaria has been eradicated from the United States, and, starting in 1958, the World Health Organization has instituted a campaign to eradicate the scourge from the entire world within ten years.

Canada has been relatively free from malaria, with the exception of the St. Lawrence and Rideau valleys. We read in the Jesuit Relations that from the earliest days of French Canada missionaries and traders suffered from the ague, and later agricultural settlers in Upper Canada frequently experienced chills

and fever that responded to treatment with quinine when the pioneers could afford it. The construction of the Rideau canal was almost brought to a standstill at times by the ravages of the disease. Although in bygone years an endemic malarial region extended from the lower Columbia valley up Puget Sound to about the latitude of Bellingham, British Columbia has never experienced an epidemic. This, in spite of the fact that the province has a widely scattered population of Anopheles mosquitoes.

In British Columbia the only potential threat is that of the encephalitides, a group of diseases caused by mosquito- and tick-borne viruses. Three of these commonly affect man in North America. They are known respectively as western equine, eastern, and St. Louis viruses, but only the first has occurred here, and that sporadically in horses. Evidence of a fourth, California encephalitis, is commonly found in the blood of wild rabbits, but if this disease affects man at all, it is only in sub-clinical form. Several species of mosquito are implicated in the transmission of encephalitis virus, and the two most commonly involved, Culex tarsalis and Culiseta inornata are abundant and widespread in British Columbia. It may therefore be said that there exists the potential for an encephalitis outbreak should the right conjunction of conditions ever occur.

MOSQUITO LIFE HISTORIES

The mosquitoes belong to that group of insects that undergo complete metamorphosis. That is to say, they pass through four stages, in each of which the structure and function are completely different. These are the egg, larva, pupa, and adult stages.

The eggs are approximately one-half to one millimeter long, roughly cigar-shaped, with one end somewhat rounder than the other. They are pale when first laid, but soon darken with exposure until they become quite black. Under the microscope the surface of the egg is seen to be covered with fine reticulation that varies with the species, and may be used to a limited extent for identification. The eggs of Anopheles have the outer membrane expanded into lateral floats, and are laid horizontally on the surface of the water where they remain separated or come together in random clusters. Those of Culex and Culiseta lie vertically in raftlike clusters up to half-an-inch in diameter that are quite easily seen on the surface. Aedes eggs are laid singly, and if deposited on water will sink. They are more usually laid on mud or vegetation

in spots that will not be flooded until the following spring. They will not hatch, even if flooded, until they have been subject to a period of drying and chilling. In some species a portion of the eggs will remain unhatched after the first inundation, but will produce larvae in the second, or even the third summer. Aedes mosquitoes are unbelievably prolific. For example, a single sod, eight inches in diameter, cut from a meadow beside the Fraser, produced 3,218 larvae in the laboratory. (18)

The larva is the familiar mosquito "wriggler." When newly hatched it is scarcely thicker than a hair, and about an eighth of an inch long. This stage is rarely seen unless sought for, and lasts only a few hours before the insect sheds its skin and emerges into the next stage. There are four larval stages, each progressively larger than the one before. It is in the larval period that the insect takes in the bulk of its nourishment.

Anopheline larvae are surface feeders, and may be distinguished by the fact that they lack the prominent air tube or siphon of the culicines, and hang horizontally at the surface of the water. The culicines hang at an angle, with the siphon just penetrating the surface film, and do not confine their feeding to the top layer of the water. The siphon in culicines, and the corresponding valve-like aperture in the anophelines, are connected to the tracheal system and provide the insect's main channel for the intake of oxygen. Some oxygen can also be taken in directly through the skin from the surrounding water. As a result, larvae can survive for long periods, even though denied access to the surface, provided the water is sufficiently aerated. The terminal segment of the larva bears two pairs of anal gills, but these are involved less in the transfer of oxygen than in the preservation of osmotic balance between the body fluids and the surrounding water. In this connection it is observed that salt-water breeding species of mosquito have much reduced gills, and even within a species the size of the gills will vary inversely as the salinity of the rearing medium.

The mouth of the larva is equipped with brush-like appendages in addition to the mandibles and maxillae. With these they sweep into the mouth a current of plankton-laden water. These currents may be interestingly demonstrated by scattering some fine talc on the surface near a feeding larva. The circulating currents will then become clearly visible. The wriggler takes in everything that comes - bacteria, protozoa, algae, diatoms, and inert particles, even including sand grains with a diameter up to three tenths of the width of its own head. Nourishment is also obtained

from materials in solution in the ingested water. In addition, the larva can use its mandibles to scrape food from inert surfaces, and will even eat cast larval skins and the dead larvae of its own and other species.

The period spent in the larval stage varies with the temperature of the water, and with the food supply, and may extend over two to fourteen days in our climate. All mosquito larvae are aquatic; none can develop in the absence of water.

When feeding is complete the larva molts for the last time and the pupa emerges from the cast skin. The pupa is a resting stage, in which the insect does not feed, but undergoes great changes in its internal structure. During this period, seen from the side, it appears like a large black comma hanging at the surface of the water, with two small respiratory tubes extending to, and penetrating the surface film. It is extremely sensitive to any disturbance, and will dive to the bottom if the merest shadow passes over it. The pupa propels itself downward by means of a pair of paddles attached to the last abdominal segment and activated by violent contractions of the entire abdomen. It is naturally buoyant, and returns to the surface without effort. The pupal stage lasts for several days, after which the skin splits down the back and the adult mosquito struggles out, rests for a while on the raft formed by the cast skin, then flies away to seek a sheltered refuge.

For the first few days after emergence the adult mosquitoes are inactive. The last of the larval tissues are absorbed, and formation of the adult internal structures is completed. After this comes the final chapter of the life history. The males of most species swarm at dusk over selected "markers," that may be trees, bushes, or even cow-pats or darkened moist patches on the ground. Here the females seek them out for mating, then go about their primary task of egg formation.

Both sexes maintain their carbohydrate requirements by sucking the nectar of flowers, but in most species the females cannot form eggs until they have obtained a supply of protein which they get by sucking the blood of some other animal. Not all species require human blood. Some prefer that of cattle or pigs, some attack birds, and a few satisfy their needs with the cold blood of reptiles or amphibians.

The males are short-lived, and do not survive long after mating. Most aedine females perish soon after egg-laying, but

members of some other genera pass through nine to twelve egg-producing cycles, each involving another blood meal. This succession of meals provides the channel for the transmission of disease from one host to another.

Photo 2 Female mosquito in act of engorging.

In British Columbia two main types of life history are evident. Our principal pest species belong to the genus Aedes, whose members overwinter in the egg stage. Hatching occurs with flooding in the spring, and the adults emerge in May or June. There is generally only one brood per year, and the average life span of the females is about six weeks, although unusual weather conditions may shorten or extend this range considerably. The genera Anopheles, Culex, and Culiseta all spend the winter as fertilized females, whose eggs are laid in early summer. In the case of most of these there may be several generations in the course of a single season. At the end of the summer mating takes place, the males die off, and the surviving females seek refuge in dark, sheltered spots such as basements, root cellars, or culverts. Here they lie dormant until the lengthening days of spring arouse them to activity.

We have a few species whose habits depart markedly from the general plan. Aedes sierrensis and A. triseriatus are mosquitoes whose larvae develop almost exclusively in the rain-water accumulated in treeholes. Mansonia perturbans has a peculiar adaptation of the larval siphon and the pupal breathing trunks by which the aquatic stages attach themselves to the stems of underwater plants and obtain their oxygen requirements therefrom without ever coming to the surface. The winter is passed in the larval stage. A. sierrensis and M. perturbans are both found, widely scattered, in the Fraser Valley, but neither is really common. A. triseriatus has been recorded only once in the Okanagan valley.

ECOLOGICAL GROUPINGS

Many mosquito species require a very precise set of ecological surroundings, so that in some areas an experienced mosquito worker can approach a breeding spot and predict with a high degree of accuracy the species of larvae that he will find therein. In British Columbia this is true to only a limited extent. Possibly due to the fact that the terrain is so varied, with mountain and valley, grassland and forest so closely intermingled, some mosquito types have invaded and adapted themselves to habitats normally foreign to their species. The result is that a worker who scouts breeding places on a strictly textbook basis may meet with occasional surprises. However, some generalizations can be made concerning the most troublesome species.

Bodies of water in which breeding occurs may be classified as temporary, recurrent, or permanent. Almost all species having only one brood per year develop in temporary pools, while those that produce several generations per season are found in the recurrent or permanent bodies.

Temporary Pools

a. Flood waters The major rivers of British Columbia all have their origin in the glaciers and snowfields of the mountains. In consequence their levels fluctuate widely and varying degrees of flooding occur in their valleys each spring. The lands thus flooded are our major source of pest mosquitoes. Where the inundated land is covered by cottonwoods or willows, Aedes sticticus breeds in vast numbers, and some A. cinereus may be found. Where the bush has been cleared and the land is in meadow, A. vexans predominates, but Culex tarsalis will run a

fairly close second to it in abundance. The lower Fraser Valley is the most important habitat for these species, as it provides the largest area subject to flooding, and is

Photo 3 Flooded alder bottom, a breeding area for Aedes sticticus

occupied by the heaviest concentration of people, but the many rivers running into the coastal inlets will all make their contribution, particularly of A. sticticus. A peculiarity of this type of habitat is that the eggs hatch after the peak of a flood. It sometimes happens that a river will show several successive peaks with a fresh hatch after each - a circumstance that greatly complicates the work of pest control.

Since the main source of the flood waters lies at high altitudes, the river peaks arrive long after the snow has gone from the valleys, and may coincide with very hot weather. This greatly shortens the pre-adult life of the mosquitoes, and reduces the time during which effective control measures may be applied. Such a combination of circumstances took place in the Fraser Valley in 1960, when the first larvae were found on 30th May, and the adult population emerged en masse by 6th June.

Photo 4 Pool formed by seepage through road embankment from a flooded river.

Photo 5 Typical snowpools on rangeland.

b. Snowpools The melting snows of early spring form a multitude of pools in undrained depressions. These newly-formed bodies of water are deficient in natural predators, and produce a wide variety of species that are able to pass their aquatic stages before the pools dry up and with little hazard from their enemies. In the open grasslands, Aedes campestris, A. fitchii, A. increpitus and A. pullatus are common, but smaller numbers of A. excrucians, A. flavescens, A. spencerii, A. punctor, and A. intrudens are also found.

Photo 6 A flooded mountain valley, providing breeding areas for Aedes vexans, A. pullatus, A. punctor, and A. communis.

In the high mountain valleys, Aedes cataphylla, A. communis A. hexadontus, A. pionips, and A. punctor are snowpool breeders in varying degrees of abundance.

c. Woodland Pools Snow- and rain-pools in the forest form another habitat in which Aedes communis, A. punctor, and A. stimulans are abundant, but also found are A. canadensis, A. diantaeus, A. excrucians, and Culiseta impatiens, with occasionally A. aboriginis and A. trichurus.

d. Treeholes A very specialized habitat is that found in treeholes. Cavities left when branches are torn off, or formed by the conjunction of several stems, accumulate organic debris and rainwater that together form a rich rearing medium. Here are found the larvae of Aedes sierrensis, A. hendersoni, and A. triseriatus. The first of these is widespread, though not numerous, in the coastal valleys, but the two latter are exceedingly rare.

Recurrent Pools

a. Salt Marshes Along the east coast of Vancouver Island, in the Fraser Delta, and at the heads of many coastal inlets are tidal marshes in which are found the breeding pools of Aedes dorsalis. While this species can tolerate a high degree of salinity it will also develop in brackish water, and even in rainpools. It is also found in many of the saline pools of the Interior Plateau. Not all of its eggs hatch at the first flooding, and in the salt marshes a new brood may be looked for after any particularly high spring tide throughout the summer.

Photo 7 Debris-choked river backing up flood water to form extensive breeding areas.

b. Irrigation Seepages Much of the irrigated land of British Columbia is planted in orchards, many of which lie on well-drained bench lands. Water rarely accumulates in such situations, and where it does, the spray residues from the orchards will often inhibit breeding. Irrigated hay lands pose a more serious problem, as they are commonly bottom lands and are rarely sprayed for crop protection. Where water is permitted to accumulate and lie, Culex tarsalis, Aedes vexans and A. dorsalis may develop in great numbers, with a fresh brood at each flooding, and will constitute a severe detriment to workers and horses at haying time. Anopheles freeborni and A. punctipennis may also be found, but are rarely very numerous.

Photo 8 Permanent swamp formed by seepage from creek.

Permanent Pools

Large and deep bodies of permanent water and river backwaters are not mosquito producers, except where they have shallow, weedy margins. However, there do exist numerous permanent, shallow swamps and ponds. These may produce Culex tarsalis and C. pipiens as well as Anopheles species. In general, natural waters of this type are not important sources. More serious

is the problem arising from artificially maintained bodies such as sewage stabilization lagoons and log ponds. Culex tarsalis and C. pipiens thrive mightily in these waters, whose high organic content renders most insecticides ineffective.

Artificial Containers

Culex pipiens was once commonly known as the rain-barrel mosquito. Rain barrels are no longer maintained in most areas, but there are many types of container that serve mosquitoes equally well. Fire barrels on railway trestles, old oil drums, tin cans, cemetery vases, and old tires will hold accumulations of water that will produce significant numbers of Culex pipiens, Culiseta incidens, Aedes sierrensis, and sometimes Anopheles species. C. pipiens has been found breeding even in septic tanks, to which it gains access by flying down the ventilating stacks of domestic plumbing systems.

THE PRINCIPLES OF MOSQUITO CONTROL

A generation or two ago mosquitoes were accepted as a pest that could not be cured, and must be endured. No longer is this the case, and almost every community of any size makes some attempt to carry out control measures. Unfortunately, in the past much misinformation as to methods has been promulgated, and much money has been wasted on inefficient materials and unsuitable equipment. Any community that is contemplating mosquito control for the first time should seek the advice that is freely available from government sources.

At the outset, it must be realized that mosquito control is a community matter. Mosquitoes have no regard for fence lines or municipal boundaries, and the larger the area brought under a single control project, the better will be the result.

There are three possible approaches to any mosquito abatement problem. In order of importance and efficiency they are source reduction, larviciding, and adulticiding. Source reduction is the permanent and efficient solution to the problem. Mosquito larvae can develop only in water. If no water is available to them there will be no mosquitoes. Unfortunately the efficiency and true economy of this approach is sometimes obscured by the high initial cost of the engineering work involved in the draining of pools and the dyking and ditching of flood plains. It must be remembered that once this work is done the mosquito source no

longer exists, and requires no annual treatment beyond normal maintenance of dykes or ditches. Furthermore, filled-in land may provide valuable building sites, and the elimination of standing water will improve the productivity of farm land.

Photo 9 Drainage ditch effectively eliminating a breeding area in 12 acres of swamp near Merritt, B. C. (Photo by G. Allen Mail)

If breeding sites cannot be completely eliminated, the next best plan is to deny their use to the mosquitoes. This is usually done by making the water chemically unsuitable for the emerging larvae by the use of insecticides. Since the larvae are confined to their native water and cannot escape, this method is efficient, provided that all bodies of breeding water are discovered and treated. On the debit side, it must be remembered that insecticides are potent poisons to many other forms of life, and they must be judiciously selected and skilfully applied. The term "larviciding" may be extended to include any method of encompassing the death of larvae, whether by the use of chemicals or by the encouragement of natural enemies in the form of predators or parasites. Most deep and permanent bodies of water have a resident population of fish,

water-beetles, dragonfly nymphs, and other destructive agents, and for that reason cause little concern to the control worker. Fish may be added to garden pools, sewage lagoons or other isolated pools to remove them from the active breeding list. Even natural forces such as wave action on beaches will aid in the good work. Some research is now in progress into the action of bacterial and virus diseases and fungi, but this has not yet reached the point of practical application, although there is a very considerable natural mortality from these causes.

Adulticiding is the method of last resort, to be used in situations where other methods are not possible, or where there is an air-borne invasion from distant breeding areas. In this category may be listed any method that kills adult mosquitoes. Some are fairly efficient, but all are of a temporary nature and call for renewed applications at more or less frequent intervals. The most spectacular, most popular, and most expensive of these methods is the use of aerial spray, by which a large area can be covered in a short time. The use of insecticidal fogs produced by ground-based machinery is highly efficient in killing insects present at the time, but these fogs have no residual effect, and re-infestation may take place in a few hours or a few days. A method of value in isolated spots is the use of a barrier formed by spraying a residual type of insecticide on the vegetation in a belt surrounding the area to be protected. The use of traps of various sorts has been promoted by commercial interests, but cannot be recommended where the pest is at all severe.

Great numbers of mosquitoes, both larval and adult, are killed by natural enemies ranging from bacteria to birds. We are not always able to make direct use of these agencies in our control efforts, but sometimes we can co-operate with them, and always we should avoid as far as possible the use of methods or materials that would interfere with their activities.

Larvae are commonly found to be heavily encrusted with sessile protozoa, such as Stentor, but appear to be unaffected by them. Others when captured have a milky appearance in those parts that should be transparent. These are usually affected by bacterial disease, and whereas they may pass through all the larval stages, and may even pupate, they do not produce adults. Several of these diseases are under study, but so far have not provided us with any practical control method. Other larvae are attacked by fungi with fatal effect, but again, we cannot manipulate the causal organism for our own ends.

By far the greatest cause of larval mortality is predation by a wide variety of organisms. The common "bloodworms" that are the larvae of midges, larval Chaoborini that are the mosquitoes' own first cousins, dragonfly nymphs, immature and adult water beetles, and a host of other forms prey upon the larvae, particularly in permanent pools. Minnows and small fish of all kinds are effective in clearing pools of mosquito larvae, and in many parts of the world the top-minnow Gambusia affinis is reared and and distributed for this purpose. Unfortunately its use is incompatible with the life-cycle of our main pest species, and its use would be of little value in British Columbia. Tadpoles, though commonly found in great numbers in temporary pools, do not appear to affect the wriggler population to any great degree, although they probably do compete for available food. An examination of their intestines shows them to be mainly vegetarian. Salamanders work great destruction among larvae in their own particular habitat. An aquatic plant, Utricularia, is equipped with small bladders that are capable of trapping small swimming larvae.

In addition to the effect of predation, much direct mortality results from wave action and fluctuating water levels, by which larvae are stranded.

Adult mosquitoes, as they rest near the water after emergence, fall prey to frogs and other amphibians, while dragonflies, robber flies, bats, and birds cause great losses in the air. Both larval and adult mosquitoes are often found to be parasitized by minute mermithid nematodes. Larvae die shortly after the worms leave their bodies, while adults live for a time but are unable to reproduce. Water mites are commonly found attached to flying mosquitoes, but do not appear to cause them much inconvenience, although it is surmised that in this case, too, the reproductive potential may be reduced or destroyed. (22)

In any consideration of predation the unobtrusive work of spiders must be given its share of credit. It has been calculated that in Great Britain the weight of insects eaten annually by spiders exceeds that of the human population (6), and in the sparsely populated West that ratio must be many times multiplied. In the case of the orb-weaving spiders at least, it must be assumed that mosquitoes form a fair proportion of their diet.

By far the most important natural enemy of the adult mosquito is the weather. All small insects, having a high ratio of surface to volume, are in constant peril of drying-out, and for this reason mosquitoes are commonly found harbouring in meadows and

hayfields where the vegetation provides the necessary shade and humidity. Any unusually hot and dry summer produces a rapid decrease in the density of mosquito populations, and conversely a mild and moist one maintains the pest at a high level.

COLLECTING AND PRESERVING METHODS

For purposes of identification both adult and larval mosquito specimens must be collected. Determination of species depends in both cases to a great extent upon the position and number of delicate scales and hairs that are easily rubbed off and lost. For this reason, the use of incorrect methods of collecting will result only in frustration and loss of time and effort. The methods outlined herein will offer the greatest possibility of obtaining usable specimens.

a. Larval Collections

Larvae are best caught with a long-handled dipper. Some skill is required to get a good sample, as the larvae are easily scared and will dive to the bottom when disturbed. The operator should wait after getting into position for long enough to allow the divers to return to the surface. If this is not done the collection may be biased, as some species are more timid than others, diving on slighter stimuli, and staying down longer. The sweep with the dipper should be made quickly and cleanly. When scooped up, the larvae are best transferred to vials or jars with an eye-dropper that has had the tip cut back to make a larger opening. If large numbers of larvae are required for rearing, a kitchen strainer mounted on a long handle may be swept through the water. The strainer is then immersed in a suitable vessel of water and emptied of larvae by a rotary motion.

Live larvae are difficult to transport over any great distance and will quickly perish if sloshed around in an open container while travelling by car. A much better method is to use sealers, filled to the top, leaving no air space, and with the top screwed on. Larvae will survive quite happily thus for several hours. In our own experience the best way of all is to use plastic bags that can swing freely when hung from above by a string. If obtainable, those with a screw cap are ideal, but any watertight bag will serve.

If larvae are to be submitted for identification, they may be killed by dropping them into water that has just stopped boiling and then placed in 70% alcohol in a vial, or they may be put directly into the alcohol. If they are to be permanently preserved the alcohol should be renewed after 24 hours. The label should bear at least the place and date of capture and the collector's name. Any other pertinent data may be added. Labels should be placed inside vials, not pasted on the outside. Since ordinary ink will run, pencil may be used. The most permanent record is made by writing the label in india ink and dipping it in 5% acetic acid (or vinegar). It is important that no bubbles be allowed to form in the vial, or they will knock off some of the diagnostically important bristles and spines. In ordinary vials a wad of cotton wool may be pushed down far enough to isolate the bubble in the upper portion. An excellent method is to obtain from a dentist some of the tubes in which local anaesthetic is packed. These are closed with a rubber bung. In use, the tube is filled to the brim with preserving fluid, the larva and label inserted, and the rubber stopper is applied with a pin between it and the rim. Any air trapped under the stopper escapes through the small space around the pin, which is then withdrawn.

For taxonomic purposes the ideal adult specimens are those reared from live larvae in the laboratory. For this purpose the larvae are placed in shallow pans and fed on small amounts of brewer's yeast or Pablum, finely ground. Care must be taken not to overdo the feeding. Too little will merely slow down development. Too much will foul the water and kill the brood. When the pupae appear they are transferred in shallow vessels to suitable cages for emergence. The resulting adults, given 24 hours to mature, will be in perfect condition.

In some cases it is desirable to associate the emerged adult with its own larval skin. To do this, individual larvae are isolated in rearing vials for development, and when pupation takes place are put under individual cages made from lamp chimneys for emergence. The cast larval skins are preserved and numbered, and the adult specimen after emergence is labelled with the same number. It has been found that the larvae are gregarious and will thrive better in isolation if a number of vials are placed close together so that the larvae are aware of their neighbours' movements.

b. Adult Collections

There are numerous methods of obtaining adult mosquitoes, depending upon the purpose for which they are required. Light traps and sweeping with nets will take a gross sample of a population, but as mentioned before they are likely to be in poor condition for purposes of identification, and quite useless as museum specimens. Females may be captured on the person when they come to feed, but males are rarely so taken. By all means, the best way of getting good specimens of either sex is to rear them.

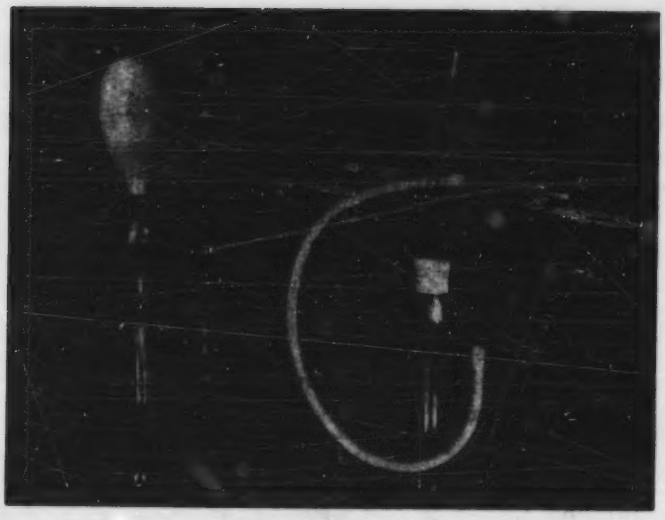
To sample a biting population specimens may be taken as they bite, with a killing vial. This is made by placing some pieces of scrap rubber in the bottom of a one-inch shell vial, covering them with a plug of cotton wool, and holding all in place with a disc of blotting paper. A small quantity of chloroform or carbon tetrachloride is added. The rubber will absorb the liquid and retain it for a long period. In use, the vial is inverted over the resting mosquito, which soon falls to the bottom. The cork is inserted and the specimen is quickly killed.

If the specimen is required alive for the production of eggs, a cone-jar is used. This is composed of a wide-mouthed sealer with an everted metal cone substituted for the cap and held in place by the screw-ring. A few strips of crumpled paper are placed in the jar. In operation, the mosquito is allowed to feed to repletion on the arm of the operator. As soon as it shows signs of finishing its meal the open (small) end of the cone is placed over it. The mosquito is then in semi-darkness, and will fly to the light coming from the body of the jar. The tip of the cone is then closed with a cork and the specimen finds a resting place among the crushed paper strips. Its survival during transport will be enhanced if the paper is slightly dampened but not wet.

Dead specimens should be pinned as soon as possible. This is best done under a magnifier or low-power microscope. The insect is laid on its left side, with the head pointing to the right of the operator. A tiny blob of shellac is applied to a No. 1 insect pin, about one third of the way down from the head. The pin is held by the tip and the shellac blob is brought into contact with the right side of the thorax of the mosquito, which then adheres permanently to the pin.

Lamp-chimney cage for rearing isolated pupae.

Cone jar and killing vial for collection of adult specimens.



A. Pipettes for handling larvae singly or in bulk.

B. Aspirator for collection of adult specimens.

In this way the top, bottom, and left side of the specimen are available for inspection. Immediately below the specimen is pinned the label showing the place and date of collection and the collector's name. Other data, such as the specific name, the name of the determiner, or ecologic information may be added on separate labels. It is not always possible for specimens to be pinned immediately on capture. In that case, they should be placed tenderly between layers of cellucotton or tissue in a pillbox, with the label data on the cover. If they are put loosely in a vial or crushed in an envelope, they will be denuded of the scales and hairs that are so important for identification purposes.

MOSQUITO IDENTIFICATION

Almost everyone would claim to know what a mosquito looks like, yet control workers receive a surprising number of calls arising from the presence of flies that are not mosquitoes at all. Most of these prove to be crane flies that, like mosquitoes, are two-winged, slender flies with long legs, but lack the characteristic features of the mosquito - scaly wings and a proboscis. In the larval stage, too, there are insects easily mistaken for mosquitoes. Immature Chaoborini bear a strong likeness to the larvae of Anophelini, but are distinguished from them by the possession of prehensile antennae that are equipped with long and strong spines. These they use for preying upon other aquatic larvae, including those of mosquitoes.

The following keys cover the identification of all species of mosquitoes yet found in British Columbia, with the addition of a few that occur in contiguous territory and may yet be collected within our boundaries. In applying them, the beginner is cautioned that the characters used for the identification of mosquitoes show a considerable range of variation between individuals of a single species, and the final determination must be based upon the sum total of all known characters, even if one or more depart somewhat from those in the written description.

Keys to the male genitalia have not been included, since few of the public to whom this work is addressed will have the training or equipment required for their preparation and mounting, and the more advanced workers will have access to the excellent keys and diagrams found in publications listed in the bibliography.

Practically all the characters mentioned in the keys can be seen with the aid of a low-powered stereoscopic microscope having magnification up to X40. The exceptions are the tarsal claws in the adult and the comb scales in the larva, which require the use of high power.

An ordinary cork makes a good mount for pinned specimens under the microscope, while a Syracuse watch glass or other shallow dish is a convenient vessel for larvae, which should be submerged in saline solution or preserving fluid for examination. We are speaking here of gross specimens, and not slide-mounted material, which is used with a high-powered microscope. A strong light that can be focussed on the specimen is essential.

The descriptionsof the species have been kept as simple as possible, and include only those characters necessary for recognition. Similarly, only the most important synonyms are quoted.

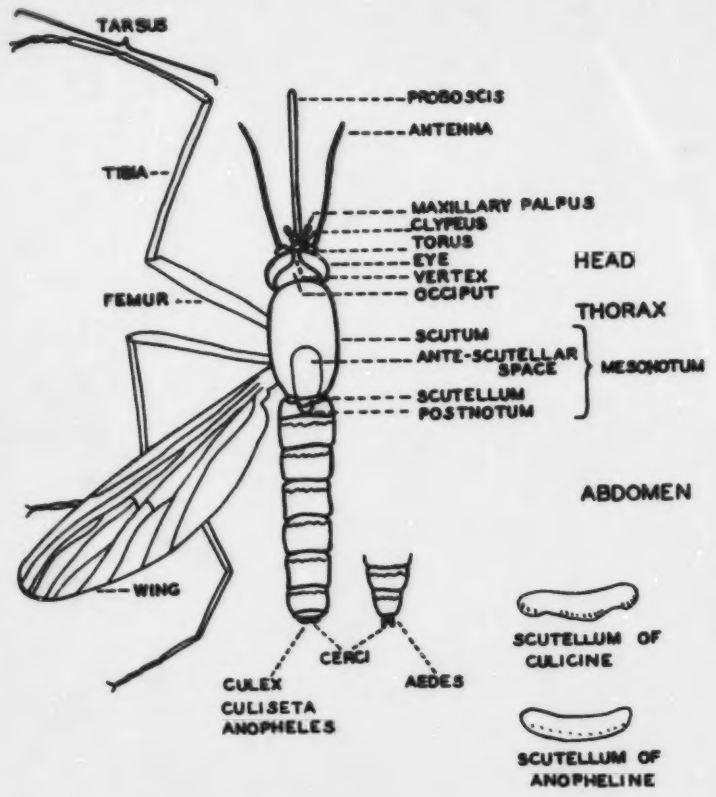


Fig. 1. Principal parts of a female mosquito.

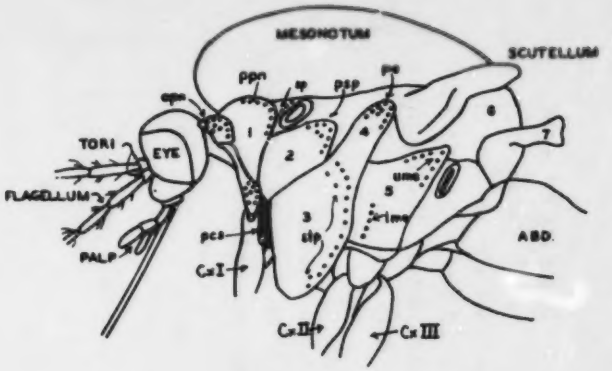


Fig. 2. Lateral view of generalized mosquito thorax. ABD, abdomen; Cx, coxa; pcs, post-coxal scale patch. Sclerites: 1, postpronotum; 2, mesanepisternum; 3, sternopleuron; 4, pre-alar area; 5, mesepimeron; 6, postnotum; 7, haltere; Setae: apn, anterior pronotal; lme, lower mesepimeral; pa, preantennal; psp, postspiracular; sp, spiracular; stp, sternopleural; ume, upper mesepimeral.

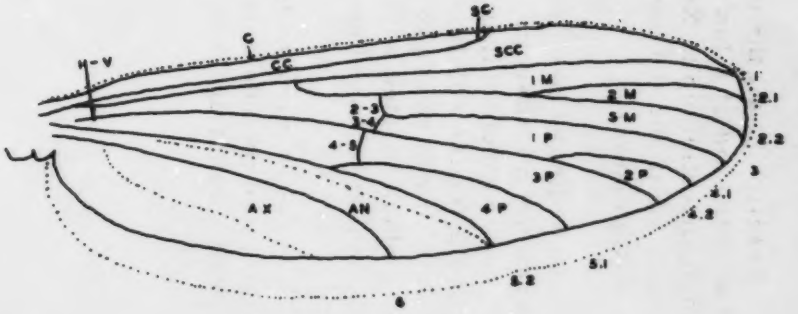


Fig. 3 Terminology of the mosquito wing. Cells: AN, anal; AX, apical; CC, costal; SCC, subcostal; 1M, 2M, 1st & 2nd marginal; 1P,2P,3P,4P, 1st, 2nd, 3rd, & 4th posterior; Veins: C, costa; SC, subcosta; H-V, humeral cross-vein; 2-3, 3-4, 4-5, cross-veins; longitudinal veins and branches as numbered. Outer dotted line indicates marginal fringe of narrow scales.

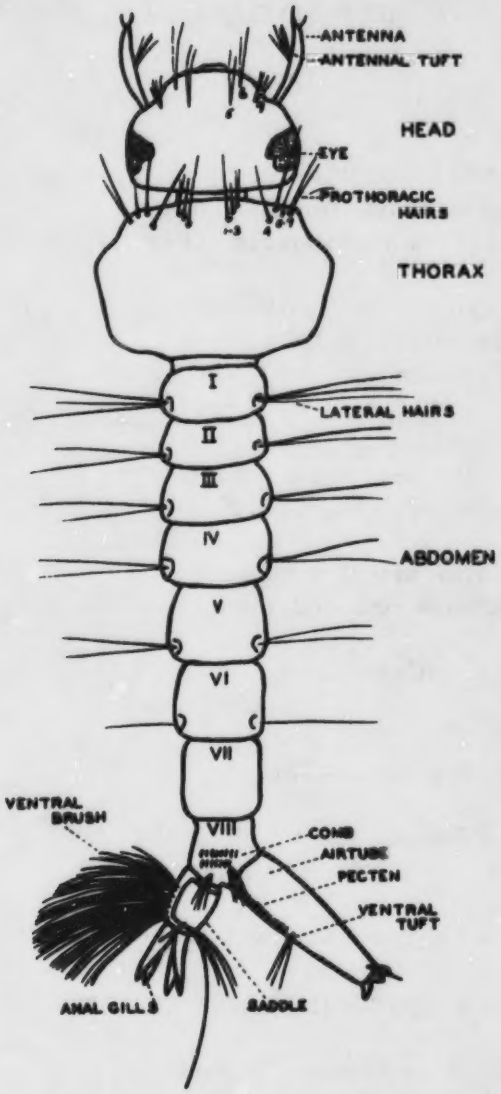


Fig. 4. Dorsal aspect of a 4th instar culicine larva.

Head hairs:- 5, upper; 6, lower; 7, preantennal; Prothoracic hairs as numbered; I-VIII, abdominal segments.

KEY TO GENERA

ADULTS

1. Scutellum trilobed, with marginal setae on lobes only; female palpi much shorter than proboscis. (Fig. 1) 2.

   Scutellum crescentic, with setae evenly distributed; palpi almost as long as proboscis. (Fig. 1) Anopheles

2. (1) Postspiracular bristles present; abdomen tapered. (Figs. 1, 2) Aedes

   Postspiracular bristles absent; abdomen bluntly rounded. 3.

3. (2) Spiracular bristles present (Fig. 2) Culiseta

   Spiracular bristles absent 4.

4. (3) Wing scales broad, light and dark mixed. Mansonia

   Wing scales narrow, all dark Culex

FOURTH INSTAR LARVAE

1. Eighth abdominal segment without a siphon. (Fig. 5) Anopheles

   Eighth segment with a siphon or air tube. 2.

Fig. 5

2. (1) Distal part of air tube reduced, with saw-like teeth; pecten teeth absent. (Fig. 6) Mansonia

   Air tube elongated and slightly tapering. 3.

Fig. 6

3. (2) Air tube with siphonal tuft at base. (Fig. 7) Culiseta

Fig. 7

Tufts of air tube within or distal to pecten. 4.

4. (3) Air tube with several pairs of tufts distal to pecten. (Fig. 8) Culex

Fig. 8

Air tube with only one principal pair of tufts, usually distal to pecten. Aedes

KEY TO SPECIES IN GENUS ANOPHELES

ADULTS

1. Wings with areas of pale scales punctipennis

Wing scales dark, except for bronzy fringe spot at apex in two species. 2.

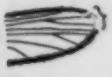
2. (1) Tip of wing with uniform fringe (Fig. 9) freeborni

Fig. 9

Tip of wing with bronzy fringe-spot. (Fig. 10) 3.

3. (2) Scales on stem of vein 2, between fork and dark spot, raised. (east of Rockies) earlei

Fig. 10



Scales on stem of vein 2 closely appressed. occidentalis

FOURTH INSTAR LARVAE

1. Inner clypeal hairs 2, forked beyond middle (Fig. 11a) earlei

Fig. 11

Inner clypeal hairs 2, simple. (Fig. 11b) 2.

2. (1) Antepalmate hair 2 on segments IV and V of abdomen usually single (Fig. 12a); post-clypeal hair 4 multiple (Fig. 11c) occidentalis

Antepalmate hair 2 on segments IV and V usually double or triple (Fig. 12b) 3.

3. (2) Antepalmate hair on segments IV and V usually double; postclypeal hair 4 usually bifurcate at middle to base. (Fig. 11b) freeborni

Antepalmate hair 2 of segments IV and V usually 3- or 4-branched; post-clypeal hairs bifurcate from insertion points. punctipennis

Fig. 12

KEY TO SPECIES IN GENUS AEDES

ADULTS

1. Tarsal segments with white rings (Fig. 13a-c) 2.

Tarsal segments unbanded (Fig. 13d) 14.

2. (1) Tarsal segments with basal bands only (Fig. 13b,c) 3.

Tarsal segments with basal and apical white rings (Fig. 13a) 10.

Fig. 13

3. (2) Basal rings on tarsi broad, especially on hind legs. 4.

Basal white rings narrow. (Fig. 13b) vexans

4. (3) Abdominal tergites yellow-scaled, without white bands. flavescens

Abdominal tergites dark-scaled, with basal white bands. Few to many scattered white scales in some species. (Fig. 14) 5.

Fig. 14

5. (4) Front tarsal claws with main tooth abruptly bent near base of lateral tooth. Main and lateral teeth parallel. (Fig. 15a) excrucians

Front tarsal claws with main tooth bent beyond base of lateral tooth. 6.

Fig. 15

6. (5) Front tarsal claws with lateral tooth short and blunt, less than half as long as main tooth. Main tooth bent before tip. (Fig. 15b) riparius

Front tarsal claws with lateral tooth long and slender, about half length of main tooth. (Fig. 15c) 7.

7 (6) Lower mesepimeral bristles absent (in part) fitchii

Lower mesepimeral bristles present. (Fig. 16) 8.

Fig. 16

8. (7) Tori (Fig. 17) without white scales on dorsal surface; palpi without hairs on basal half of inner ventral surface of apical segment. increpitus

Tori with white scales on dorsal surface, or with hairs on palpi as described above. 9.

Fig. 17

9. (8) Lower mesepimeral bristles 1 or 2; white scales on tori. (in part) fitchii

Lower mesepimeral bristles 3 or 4; tori with or without white scales. stimulans

10. (2) Wing with light and dark scales intermixed. 11.

Wing scales all dark, or with some white scales on anterior veins. 13.

11. (10) Vein 6 with more dark scales than light; cluster of white scales at tip of palpi; scales on pleuron broad and squared-off. melanimon

Vein 6 light-scaled; few white scales along palpus, but not at tip; scales on pleuron narrow. 12.

12. (11) Wing scales with light and dark evenly mixed; tarsal claw with main tooth straight in middle portion, lateral tooth slender and nearly parallel to main tooth. campestris
Scales on third vein mostly dark; lateral tooth of tarsal claw short, and set at a wide angle from evenly-curved main tooth. dorsalis

13. (10) Wing with patch of white scales at base of costa sierrensis
Wing with base of costa dark canadensis

14. (1) Mesonotum with sides and anterior margin clad in silvery-white scales hendersoni triseriatus
Mesonotum without silvery-white scales 15.

15. (14) Wing scales distinctly bicoloured. spencerii
Wing scales predominantly dark, perhaps with white patch at base of costa. 16.

16. (15) Mesonotum lacking contrasting lines or stripes. 17.
Mesonotum with contrasting stripes 23.

17. (16) Lower mesepimeral bristles present (Fig. 16) 19.
Lower mesepimeral bristles absent 18.

18. (17) Abdominal segments without basal bands, or with rudimentary bands cinereus
Abdominal segments with basal white bands widening laterally (in part) intrudens

19. (17) Mesonotum with many long, dark setae, producing a hairy appearance. 20.
Mesonotum moderately clad with normal setae. 21.

20. (19) Tarsal claw strongly curved, with a slender tooth making an extremely acute angle. (Fig. 18a) impiger

Tarsal claw gently curved, with a blunt tooth making a much wider angle. Length of tooth about equal to depth of main claw at junction. (Fig. 18b) nigripes

Fig. 18

21. (19) Mesepimeron bare on lower one-quarter to one-third. (Fig. 19) (in part) intrudens

Mesepimeron with scales to lower margin. 22.

Fig. 19

22. (21) Wings with white scales scattered along costa, sub-costa and vein 1. cataphylla

Wings dark, except for a patch of white at base of costa.
(in part) hexadontus
(in part) punctor
punctodes

23. (16) Lower mesepimeral bristles present. (Fig. 16) 24.

Lower mesepimeral bristles absent. 32.

24. (23) Hypostigmal spot of few to many white scales present. (Fig. 20) 25.

Hypostigmal spot absent. 27.

Fig. 20

25. (24) Mesonotum with paired bare submedian stripes separated by a pair of narrow stripes of light brown scales with a narrow bare line between them. pullatus

Mesonotum with a broad brown stripe or paired stripes. 26.

26. (25) Sternopleuron with scales reaching about halfway to anterior angle. (Fig. 21) (in part) implicatus

Scales of sternopleuron reaching to anterior angle. (Fig. 22) trichurus

Fig. 21

Fig. 22

27. (24) Abdominal tergites with narrow pale bands, when present at all, on less than half the segments.
(in part) diantaeus

Basal white bands present on more than half the segments. (Fig. 14) 28.

28. (27) Wings usually without a patch of scales at base of costa. aboriginis
(in part) punctor

Wing usually with a white patch at base of costa. 29.

29. (28) Post-coxal scale patch absent. communis

Post-coxal scale patch present. (Fig. 23) 30.

Fig. 23

30. (29) Base of costa with numerous white scales; scales on margin of mesonotum silvery-grey. (in part) implicatus

Base of costa with very few pale scales; scales on lateral margin of mesonotum yellow or dark. 31.

31. (30) Bristles of scutellum and mesonotum almost all dark. pionips

Bristles of scutellum and of mesonotum yellow or bronzy (in part) hexadontus

32. (23) Abdomen with basal white bands on more than half the segments (Fig. 14) sticticus

Abdomen without white bands or with narrow bands on less than half the segments. 33.

33. (32) Sternopleuron with 12 to 20 setae. (Fig. 24) (in part) diantaeus

Fig. 24

Sternopleuron with usually 5 or 6, not more than 10, setae. (Fig. 25) decticus

Fig. 25

FOURTH INSTAR LARVAE

1. Anal segment completely ringed by the saddle. (Fig. 26a) 2.

   Anal segment not completely ringed by the saddle. (Fig. 26b) 4.

Fig. 26

2 (1) Pecten with one or more teeth widely spaced. (Fig. 27) nigripes

   Pecten with all teeth evenly spaced. 3.

Fig. 27

3. (2) Comb of segment VIII with 4 to 9 scales in a single row. (Fig. 28) hexadontus

   Comb of segment VIII with 10 to 20 scales in an irregular row or patch. punctor

Fig. 28

4. (1) Pecten of air tube with one or more teeth widely spaced. (Fig. 27) 5.

   Pecten with all teeth evenly spaced. 16.

5. (4) Air tube with tuft within pecten. 6.

   Single tuft beyond pecten 7.

6. (5) Air tube with tuft within pecten and several beyond it. (Fig. 29) trichurus

   Air tube with no tufts beyond pecten. cataphylla

Fig. 29

7. (5) Antennae as long as, or longer than, the head. diantaeus

   Antennae shorter than head. 8.

8. (7) Scales of comb on segment VIII in a patch three or more rows deep. (Fig. 30) 9.

   Scales of comb in a single, or irregular double, row. 11.

Fig. 30

9. (8) Gills short and budlike (Fig. 31a) (in part) campestris

Gills slightly shorter than anal segment to twice as long. (Fig. 31b) 10.

Fig. 31

10. (9) Air tube 4 to 5 x 1; lateral abdominal hairs usually double on segments I and II, single on III-IV. excrucians

Air tube 3.2 to 4 x 1, lateral abdominal hairs double on all segments. (in part) flavescens

11. (8) Upper head hair 5 triple or multiple (Fig. 32) 12.

Upper head hair 5 single or double. 14. Fig. 32

12. (11) Upper head hair 5 in 5 or more; gills very long and pointed. cinereus

Upper head hairs in less than 5. 13.

13. (12) Saddle of anal segment deeply incised on ventral margin. (Fig. 33); anal gills short and bluntly pointed. intrudens

Fig. 33

Saddle not deeply incised; tuft of small hairs on air tube close to pecten. vexans

14. (11) Antennae two-thirds to three-quarters as long as the head; head hairs coarse and cylindrical. decticus

Antennae not more than half as long as head; head hairs tapered. 15.

15. (14) Thorax and abdomen minutely spiculate. spencerii

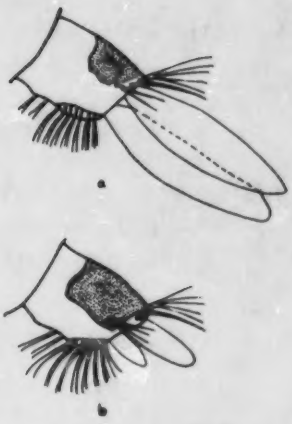
Thorax and abdomen smooth riparius

16. (4) Antennae smooth; antennal tuft represented by a single hair. 17.

Antennae spiculate; antennal tuft double or multiple. 19.

17. (16) Saddle of anal segment not reaching halfway down the segment; lateral hair double and outside the saddle. (Fig. 34a) hendersoni

Saddle reaching halfway down the segment; lateral hair single or multiple and piercing the saddle (Fig. 34b) 18.



18. (17) Lateral hair of anal segment multiple; ventral pair of gills much shorter than dorsal pair. (Fig. 34b) triseriatus

Lateral hair single; gills long and stout, bluntly rounded. sierrensis

Fig. 34

19. (16) Individual comb scale with a strong central spine, lateral spinules weak. (Fig. 35a) 20.

Comb scales evenly fringed with spinules or with subapical spinules at least two-thirds as long as central spine. (Fig. 35b) 25.

Fig. 35

20. (19) Air tube slender, 4 or 5 x 1 fitchii

Air tube stout, usually less than 4 x 1. 21.

21. (20) Comb of segment VIII with 8-15 scales. 22.

Comb of segment VIII with 18 or more scales. 23.

22. (21) Saddle of anal segment reaching nearly to mid-ventral line; gills usually less than 1.5 times length of anal segment. punctodes

Saddle of anal segment reaching halfway or a little more down the side; gills 2-4 times length of anal segment. impiger

23. (21) Lateral hair of anal segment longer than the saddle. aboriginis

Lateral hair shorter than the saddle. 24.

24. (23) Ventral brush of anal segment with four or more precratal tufts, reaching to near base of segment. (Fig. 36a) (in part) flavescens

Ventral brush with fewer precratal tufts, all on distal half of segment (Fig. 36b) (in part) sticticus

Fig. 36

25. (19) Upper frontal hairs 5 multiple; lower, triple or multiple. 26.

Upper head hairs 5 single to triple (rarely 4-branched); lower, single or double (rarely triple). 29.

26. (25) Comb on segment VIII of 18-25 scales in a straggling patch. (in part) sticticus

Comb of segment VIII of many scales in a triangular patch. (Fig. 30) 27.

27. (26) Comb of segment VIII of 70 or more scales in a patch. pionips

Comb of segment VIII of 25-60 scales. 28.

28. (27) Prothoracic hair I usually double; hair 5 usually triple. (Fig. 37) pullatus

Prothoracic hair 1 single; hair 5 single or double. canadensis

Fig. 37

29. (25) Tuft of air tube inserted near distal two-fifths; anal gills usually short. 30.

Tuft inserted near or before middle; gills equal to or longer than saddle. 32.

30. (29) Upper head hair usually single; pecten not exceeding middle of tube. 31.

Upper head hair usually double or triple; pecten covering nearly two-thirds of air tube. (in part) campestris

31. (30) Comb scale with strong central spine prothoracic hair 1 usually single (Fig. 38a) melanimon

Comb scale with terminal spines subequal; prothoracic hair 1 usually double. (Fig. 38b) dorsalis

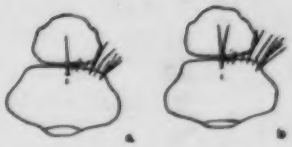


Fig. 38

32. (29) About 60 comb scales in a large patch; terminal portion of scale blunt, subequal in length to base of attachment, and fringed with subequal spinules. (Fig. 39) communis

Fig. 39

Comb scales about 20-35, not as above. 33.

33. (32) Comb scale tapering to a strong central spine flanked by progressively smaller spinules. stimulans

Comb scale blunt or rounded. 34.

34. (33) Lower head hairs 6 double or triple; terminal part of comb scale about equal to length of basal part. (Fig. 40a) increpitus

Fig. 40

Lower head hairs 6 usually single; terminal part of comb scale about one-qyarter length of basal part (Fig. 40b) implicatus

KEYS TO SPECIES IN GENUS CULEX

ADULTS

1. Tarsi and proboscis ringed with white (Fig. 13a) 2.

Tarsi and proboscis unbanded. 3.

2. (1) Femora and tibiae with a line of white scales on outer surface (Fig. 41); inner surface of tori (Fig. 17) and ventral surface of first segments of flagellum with white scales. tarsalis

Fig. 41

Femora and tibiae without line of white scales; inner surface of tori and first segment of flagellum without white scales. peus

3. (1) Abdominal segments with dorsal, basal white bands (Fig. 14) pipiens

Abdominal segments with dorsal, apical white bans or patches. territans

FOURTH INSTAR LARVAE

1. Both pairs of head hairs usually single and long, sometimes double. (Fig. 42) territans

Fig. 42

Both pairs of head hairs multiple. 2.

2. (1) Air tube with four pairs of tufts, the penultimate pair out of line; lateral abdominal hairs multiple on segments I and II, double on III-VI. (Fig. 43) pipiens

Fig. 43

Air tube with 4 or 5 pairs of tufts, all in line or nearly so; lateral abdominal hairs on segments III-VI triple. 3.

3. (2) Subapical tuft on air tube smaller and slightly out of line; saddle of anal segment indented, with spicules near apex. (Fig. 44) peus

Fig. 44

Tufts on air tube uniform; saddle of anal segment with smooth adges and no spicules. tarsalis

KEYS TO SPECIES IN GENUS CULISETA

ADULTS

1. Hind tarsi with white rings on some segments. (Figs. 13b, c) 2.

   Hind tarsi entirely dark-scaled. (Fig. 13d) 6.

2. (1) Tarsal white rings broad; cross-veins bearing scales. (Fig. 45) 3. Fig. 45

   Tarsal rings narrow; cross-veins bare. 4.

3. (2) Femora with subapical white rings. (Fig. 46) particeps Fig. 46

   Femora without white rings. alaskaensis

4. (2) Wings with conspicuous spots of dark scales. incidens

   Wings lacking patches of dark scales. 5.

5. (4) Abdominal segments with apical and basal areas of pale scales. minnesotae

   Abdominal segments with narrow, basal pale bands. morsitans

6. (1) Wings with scattered white scales on anterior veins. inornata

   Anterior edges of wings entirely dark scaled. impatiens

FOURTH INSTAR LARVAE

1. Pecten not followed by a row of hairs; antennae subequal to length of head. 2.

   Pecten produced into a row of hairs (Fig. 7); antennae short. 3.

2. (1) Upper head hair 5 in 7-8 branches (Fig. 47a); preantennal hair in 9-12; ventral tufts of anal segment 17-18. minnesotae

Upper head hair in 4-5; preantennal hair 6-8; ventral tufts of anal segment 20 or more. (Fig. 47b) morsitans

3. (1) Saddle of anal segment with a conspicuous group of coarse spines near apex. (Fig. 48) particeps

Saddle of anal segment smooth. 4.

Fig. 47

4 (3) Upper and lower head hairs similar in length and number of branches. impatiens

Lower head hair 6 with fewer but longer branches than upper hair 5. 5.

Fig. 48

5. (4) Lateral hair of anal segment stout, equal to or longer than saddle. inornata

Lateral hair of anal segment fine and shorter than saddle. 6.

6. (5) Antenna pigmented and prominently spined; anal saddle pierced by two or three tufts. (Fig. 49a) alaskaensis

Antenna not pigmented and not prominently spined; anal saddle pierced by two, one or no tufts. (Fig. 49b) incidens

Fig. 49

SPECIES DISCUSSIONS

ANOPHELES EARLEI Vargas

Anopheles earlei Vargas, 1943. Bol. Off. Sanit. Pan-Amer. 22:8

This species very closely resembles A. occidentalis and while several authors have given characters by which the various stages of the two species may be separated, others have pointed out that there is so much regional variation in these characters that they are valid only in restricted zones. As far as our territory is concerned, any anopheline with a bronzy fringe-spot at the wingtip is A. earlei if taken east of the Rocky Mountains or in the extreme north of the province. (34) West of the Rockies and east of the Coast Range the status is at present uncertain, due to the extreme scarcity of specimens. Any adults or larvae that appear to fall within the group should be submitted to a specialist for determination, and an attempt should be made to obtain as large a sample as possible.

The larvae develop in very cold water, usually in a slowly-flowing stream or ditch with emergent marginal vegetation. The females bite viciously, and will enter houses in search of blood-meals. They have been known to attack in air so cold that no other mosquitoes were flying. This is the only anopheline found in the Yukon, or in Alaska with the possible exception of the Panhandle, where A. occidentalis may occur.

ANOPHELES FREEBORNI Aitken

Anopheles maculipennis freeborni Aitken, 1939, Pan. Pac. Ent. 15:192

Anopheles freeborni King and Bradley, 1941. Amer. Assoc. Adv. Sci. Pub. 15:65.

Female - Palpi and proboscis of equal length. Mesonotum with a central grayish stripe bearing narrow yellowish scales. Scutellum with golden-brown hairs and long, dark setae. Abdomen dark brown, with yellowish hairs. Wing with dark brown scales showing four distinct dark clusters. Fringe uniformly dark. Conspicuous bare spaces between veins towards wing-tip.

Larva - Head longer than wide, antennae spiculate, darker towards apex. Posterior clypeal hairs bifurcate near base or middle. Inner clypeal hairs single and close together. Abdomen with palmate tufts on segments III-VII, rudimentary on segments I and II. This species closely resembles A. punctipennis except for minor differences noted in the key.

Clear water, in open sunny situations such as irrigation seepages, is the favoured breeding habitat of A. freeborni. It has been taken in the Fraser Valley, and across the southern interior. It is a potential vector of malaria, and has been found naturally infected with western equine encephalitis, but is not sufficiently numerous to be important in this connection.

ANOPHELES OCCIDENTALIS Dyar and Knab

Anopheles occidentalis Dyar and Knab, 1906. Proc. Biol. Soc. Wash. 19:159

Female - Similar to A. earlei except for minor differences noted in the key. Proboscis and palpi of equal length, dark brown. Occiput with erect, dark brown, forked scales: white cluster on vertex. Mesonotum with a broad median pruinose stripe bearing narrow, pale yellow hairs. Larger dark setae on lateral areas. Abdomen dark brown, densely clad with yellow-brown hairs. Wing scales narrow, dark, arranged in distinct dark spots. Silvery-bronze fringe spot at apex. Legs dark-scaled, with narrow pale tips on femora and tibiae.

Larva - Antennae spiculate, with tuft inserted low on the shaft. Inner clypeal hairs unbranched, separated by less than the diameter of one of their tubercles. Outer clypeal hairs much branched. Frontal hairs 5 - 7 large, plumose: prothoracic hair 1 short, often branched: hair 2 long, plumose: hair 3 quite short, single. Palmate hair 1 rudimentary on abdominal segments I and II, prominent on III - VII. Antepalmate hair 2 single on segments IV and V. Lateral hair 6 long and plumose on segments I - III.

This species is generally believed to be confined to the Pacific coastal region, possibly as far north as the Alaska Panhandle, but may possibly extend its range into the Okanagan Valley and the southern Cariboo, where some confusion exists between this and A. earlei. A. occidentalis will breed in a wide range of water, including ditches, seepage, and shallow ponds, where-

ever there is emergent or floating vegetation. It is not an aggressive biter.

ANOPHELES PUNCTIPENNIS (Say)

Culex punctipennis Say, 1823. J. Acad. Nat. Sci. Phila. 3:9

Anopheles punctipennis Say, 1824. Keating's Narr. Exped. St. Peter's River. 2:357

Female - Proboscis long, black. Palpi equal to proboscis, with raised scales on the basal portion. Mesonotum with a broad pruinose stripe bearing narrow grayish scales. Abdomen dark, clad in light and dark hairs. Wings with contrasting areas of black and pale yellow scales. Legs dark, femora and tibiae tipped with pale scales.

Larva - Indistinguishable with certainty from that of A. freeborni.

In British Columbia this species has been taken only in the Fraser Valley and southern Vancouver Island. It will breed in almost any type of water, including that in artificial containers. While it bites freely, especially after dark, it is not numerous and is not considered of importance as a disease carrier.

ANOPHELES WALKERI Theobald

Anopheles walkeri Theo., 1901. Mon. Culic. 1:299.

There is a single record of A. walkeri from Esquimalt, (37) but as this is now thought to be a misidentification, the species should not be considered a part of the British Columbia fauna.

AEDES ABORIGINIS Dyar

Aedes aboriginis Dyar, 1917. Ins. Ins. Mens. 5:99

Female - This is quite a large mosquito, the wing reaching a length of 6.0 mm. Proboscis dark-scaled. Tori light brown, darker on inner surfaces. Mesonotum golden brown with paired darker median stripes and posterior half-stripes. Hypostigmal scale spot absent. Lower mesepimeral bristles, one or two. Abdomen black, with solid white basal bands, widening at the sides. Tarsi all dark. Wing dark-scaled.

Larva - Antennae spinose, less than half head length. Head hairs: upper, 3-5 branched; lower, 2-4 branched. Lateral abdominal hairs double on segments III-VI. Comb of segment VIII with many scales, each with a strong median spine flanked by a number of short, strong laterals. Air tube, 2.5 x 1. Pecten evenly spaced, ending before middle of tube. Tuft of 4-6 long hairs inserted beyond pecten. Saddle of anal segment reaching about halfway down; gills long and pointed.

The coastal rain forests form the typical habitat of this species, which has not been recorded east of Chilliwack. It is a not very persistent biter. The larvae develop in temporary rain and snow pools in wooded areas. (18)

AEDES CAMPESTRIS Dyar and Knab

Aedes campestris Dyar and Knab, 1907. J. N.Y. Ent. Soc. 15:213

Female - Proboscis black with pale scales intermixed on basal part. Tori brown, with a few white scales. Mesonotum blonde, with broad brownish median stripe. Hypostigmal spot present. Lower mesepimeral bristles 2-7. Abdomen black, with paired submedian patches of black scales surrounded by white scales on most segments. Legs with apical and basal white rings on most tarsal segments; segments 4 and 5 of front legs and segment 5 of middle legs all dark. Segment 5 of hind tarsi mostly white. Tarsal claw with main tooth nearly straight in central part, lateral tooth slender and forming a very acute angle. Wing with white and brown scales intermixed.

Larvae - Antennae short, spinose. Upper head hairs, 2-4; lower, single or double. Comb of segment VIII of many scales in a triangular patch, single scales fringed with sub-equal spinules. Pecten covering two-thirds of air tube, last tooth sometimes more widely spaced. Saddle of anal segment reaching two-thirds or more down the sides. Gills short and budlike.

In British Columbia this species appears to be confined to the dry interior, where it breeds in somewhat alkaline pools, rich in organic matter. South of the U.S. border it is reported to breed in flooded grasslands, and is sometimes associated with A. vexans. The females bite freely.

AEDES CATAPHYLLA Dyar

Aedes cataphylla Dyar, 1916. Ins. Ins. Mens. 4:86

Aedes pacificensis Hearle, 1927. Can. Ent. 59:101

Female - Proboscis dark, with scattered light scales on basal part. Tori dark brown, with white scales on inner and dorsal surfaces. Mesonotum with narrow golden scales centrally, shading off to grayish white at margins. Lower mesepimeral bristles 2-7. Abdomen black, with basal white bands. Legs, dark with scattered pale scales. Tarsi mostly black. Wings dark-scaled, with pale scales at base of costa.

Larva - Antennae short, spiculate. Upper and lower head hairs single. Lateral abdominal hairs variable, usually double on segments II to V. Comb of segment VIII with 10-25 scales in an irregular double row or patch, each scale having a strong central spine flanked on either side by short spinules. Air tube about 3 x 1. Pecten with 3 to 5 detached teeth, reaching to near the apex. Siphonal tuft inserted before the middle. Saddle of anal segment reaching well down the sides, spinose dorsally towards the apex. Gills pointed, as long as the segment.

This species occurs throughout the province, from coastal islands to the high mountains, and from the 49th parallel to the 60th. While not very common in the Fraser Valley, it is one of the predominant species in the grasslands of the dry interior. It breeds most commonly in open, grassy snowpools, but is also found in timbered areas. It bites in broad daylight, and is quite aggressive.

AEDES CINEREUS Meigen

Aedes cinereus Meigen, 1818. Syst. Beschr. Zweifl. Ins. 1:13

Female - A smallish mosquito. Proboscis and palpi dark-scaled. Tori brown, with inner surfaces darker, bearing short setae. Mesonotum covered with reddish-brown scales. Hypostigmal spot and lower mesepimeral bristles absent. Post-coxal scale patch present. Abdomen generally without white segmental bands. Tarsi unbanded, wing scales all dark.

Larvae - Antennae slender, spiculate, more than half head length. Upper and lower head hairs multiple. Lateral abdominal hairs

double on segments I and II, single on III-VI. Comb of segment VIII in a ragged double row. Scales of comb thornlike, lined with minute spicules, or apparently bare. Air tube 4 x 1; pecten reaching beyond the middle, with the last 2 or 3 teeth more widely spaced. Small siphonal tuft inserted beyond the pecten. Saddle of anal segment reaching 2/3 or 3/4 down the sides. Gills much longer than the segment, dorsal pair longer than the ventral pair.

This is a woodland mosquito of somewhat restricted flight range. One observer has recorded that it seems to prefer walking to flying. While not generally common, it may be locally abundant. Its biting habits are as patchy as its distribution, and it may be present but harmless, or at other times may attack persistently. It hatches equally well in floodwater, rainpools, or swamps. While we have adult records of the mosquito from every part of the province, it cannot be considered as of major importance as a pest.

AEDES COMMUNIS (De Geer)

Culex communis DeGeer, 1776. Mem. des Ins. 6:314

Culex lazarensis Felt and Young, 1904. Science 20:312

Aedes communis Howard, Dyar, and Knab, 1917. Mosq. No. and Cent. Amer. and W.I. 4:368

Female - Proboscis dark, palpi sprinkled with white scales. Tori dark, with white scales on inner surfaces. Mesonotum clad in yellowish scales, with paired brown submedian lines and lateral half-lines, not always well defined. Hypostigmal and post-coxal scale patches absent. Lower mesepimeral bristles 2-6. Abdomen with basal creamy white dorsal bands, widening laterally. Legs unbanded. Wing dark-scaled, usually with a small patch of white scales at base of costa.

Larva - Antennae shorter than head, spiculate, with tuft inserted before the middle. Upper and lower head hairs single, long. Lateral abdominal hairs double on segments I-V, single or double on VI. Comb of segment VIII with many scales in a triangular patch. Individual comb scale fringed with coarse spinules, the apical ones somewhat longer. Air tube 2.5 or 3 x 1. Pecten teeth evenly spaced, not reaching the middle of the tube. Tuft multiple, inserted beyond the pecten. Saddle of anal segment reaching little more than halfway down the side. Gills long, pointed.

In the past there have been conflicting reports as to the habits - particularly the biting habits - of mosquitoes identified as Aedes communis. Hocking et al (22) found large and small forms at Churchill, Man., and Hocking (21) later reported that the smaller form was autogenous and did not take blood. In 1964 Chapman and Barr (9) described a new subspecies, A. communis nevadensis based upon larval characters, and also recognized eastern and western forms of A. communis sens str. All the British Columbia specimens that have come to hand conform to the western type. Observations show that this form bites fiercely at dusk in the open, and at almost any time of day in the woods. Its flight range is quite limited. It breeds mainly in woodland pools, and is most commonly found at medium altitudes, although on occasion it may occur in cottonwood bottoms along with A. sticticus. The larvae appear very early in spring, and in fact, Wesenberg-Lund (41) reports that larvae in Denmark have hatched in midwinter when a brief warm spell thawed out the sunny margins of the pools. With the resumption of normal cold weather the pools froze over for another three months, after which the larvae were able to continue their development.

Most authors report that A. communis constitutes a severe pest, but Vockeroth (39) writes of a population at Fort Churchill that does not take blood at all. He speculates on the possibility of there being two morphologically indistinguishable strains of totally different feeding habits, as well as the chance that the biting species has been confused with an entirely different one, due to the great difficulty of separating the black-legged Aedes in the past. The problem is open to detailed study.

Observations in the Yukon have indicated that A. communis is diurnal in habit, being most active in early morning and late afternoon.

AEDES DIANTAEUS H. D. and K.

Aedes diantaeus Howard, Dyar, and Knab, 1902. Mosqu. No. and Cent. Amer. and W. I. 4:758

Female - Proboscis and palpi black. Tori light brown on outer surface, with short, dark setae on the darker inner surface. Mesonotum with pale golden scales and narrow paired or fused median stripes of brown. Hypostigmal spot of scales absent. Lower mesepimeral bristles absent, or not more than 2. Abdominal tergites dark brown with baso-lateral triangular white patches, sometimes cross-connected by a narrow white bar.

Legs black with bronzy reflections. Tarsi unbanded. Wing scales dark brown.

Larva - Antennae longer than the head, slender, nearly straight. Lower head hairs double to multiple: upper, multiple. Lateral abdominal hairs triple on segments I and II, double on III to V, single on VI. Comb of segment VIII of 8 - 12 scales, each ending in a simple, thornlike spine. Air tube rather slender. Pecten reaching about half the length of the tube, with 1 - 3 detached spines outwardly. Saddle of the anal segment reaching well down the sides, spiculate near the apex. Gills long, pointed.

This is a rare species in British Columbia, being found most often in the north. The females are active biters at all times of day. The larvae inhabit cold pools in deep forests.

AEDES DORSALIS (Meig.)

Culex dorsalis Meigen, 1830. Syst. Besch. Bek. Eur. Zwei. Ins. 6:242

Aedes dorsalis Edwards, 1921. Bull. Ent. Res. 12:300

Female - Palpi and basal part of proboscis speckled with white scales, tip entirely dark. Tori brown with white scales on inner and dorsal surfaces. Mesonotum with whitish-yellow scales and a median stripe of narrow brown scales. Brown posterior half-lines sometimes present. Hypostigmal spot of many scales. Lower mesepimeral bristles 2-6. Pleural scales all narrow. Abdomen with basal white bands, widening at the sides, and a central white stripe, leaving paired black patches on each segment. First and last two segments almost entirely white. Femora and tibiae speckled light and dark. Most tarsal segments dark, with apical and basal light bands. Main tooth of tarsal claw curved throughout, lateral tooth short and set at a wide angle. Wings with mingled light and dark scales, the dark ones predominating on costa and veins 1, 3, and 5. Some specimens have wings almost entirely dark.

Larva - Antennae short, spinose. Upper and lower head hairs single. Lateral abdominal hairs truple on segments I and II, double on III-VI. Comb on segment VIII of 20 - 30 scales in a patch, each fringed with coarse spinules that become larger towards the apex. Air tube about 3 x 1. Pecten evenly spaced,

reaching near the middle of the tube. Siphonal tuft inserted near the end of the pecten. Saddle of anal segment reaching little more than halfway down the side. Gills short, blunt.

This mosquito lives a double life in British Columbia. At the coast it is our principal salt marsh breeder, although in the Fraser delta it is not usually found more than a mile inland. On the interior plateau it thrives not only in the saline swamps and pools, but also in fresh water situations such as irrigation seepages. It favours open, sunny habitats, and is typically a mosquito of the grasslands, where its flight range may extend to many miles. The females are vicious biters by day or night.

AEDES EXCRUCIANS (Walker)

Culex excrucians Walker, 1856. Ins. Saunders. Dipt. p. 429

Aedes aloponotum Dyar, 1917. Ins. Ins. Mens. 5:95

Aedes excrucians Dyar, 1919. Ins. Ins. Mens. 7:25

Female - a large species. Proboscis and palpi sprinkled with white scales. Tori yellow outwardly, with white scales on the dark inner surfaces. Mesonotum with brown and white scales in a variable pattern, with a median, sometimes divided, brown stripe. Hypostigmal spot absent. Lower mesepimeral bristles lacking, or rarely one. Abdomen with basal pale bands and scattered posterior pale scales on the segments. A few scattered dark scales centrally on the underside. Wings mainly dark scaled, with scattered pale scales. Tarsi with basal white bands, broad on the hind legs, narrower on middle and fore legs. Front tarsal claw distinctive: claw sharply bent beyond the base of the tooth, claw and tooth nearly parallel.

Larva - Antennae short, slender, spiculate. Upper head hairs double or triple: lower, single or double. Lateral abdominal hairs double on segments I and II, single on III-VI. Comb on segment VIII of many scales in a patch. Individual scale with a thornlike central spine flanked by small spinules. Air tube slender, 4 x 1. Pecten not reaching the middle, with the last 2 or 3 teeth more widely spaced. Saddle of anal segment reaching about three fourths down the side. Anal gills long, pointed.

This species is found locally throughout British Columbia, and breeds in a wide range of temporary, shallow waters. Hearle (18) discussed this species under the name of A. aloponotum and stated that its members were confined to deep woods in the Fraser Valley. In the dry interior, they are active not only in the woods, but on the open grasslands. They generally appear somewhat later than other species, and survive well into late summer.

AEDES FITCHII (Felt and Young)

Culex fitchii Felt and Young, 1094. Science 20:312

Aedes fitchii Howard, Dyar, and Knab, 1917. Mosq. No. and Cent. Amer. and W. I. 4:682

Female - Proboscis dark, speckled with white scales, except for the distal half of the dorsal aspect. Palpi with indefinite pale rings at the base of the last two segments, last segment with a pale tip. Tori yellow, darker on the inner surface, with white scales on the inner and dorsal surfaces. Mesonotum with yellowish-white scales at the sides, and a broad single or double median stripe of narrow brown scales. Hypostigmal spot absent. Lower mesepimeral bristles none to two, rarely 3 - 4. Abdominal segments with distinct basal pale bands, sometimes with a few scattered postero-medial light scales. Wings, dark scaled with a scattering of pale ones. Tarsi with broad white basal bands on hind legs, bands reduced on mid and fore legs.

Larva - Antennae short, spiculate. Upper head hairs 2-4 branched, longer than the lower ones. Lower head hairs 1-3 branched. (Most commonly in British Columbia both are triple.) Lateral abdominal hairs generally double. Comb of segment VIII with up to 30 scales in a patch; individual scale with a stout central spine flanked by moderately strong spinules. Air tube long and slender, with the pecten not reaching the middle. Long tuft inserted about the middle of the tube. Saddle of anal segment reaching about two thirds down the side. Gills long, pointed.

In British Columbia, A. fitchii is widespread from Vancouver Island to the Rockies. It is a snowpool breeder, often associated with A. increpitus, and commonly occurs in open woods or the transition area between forest and grassland. It is an aggressive biter, and often constitutes a large proportion of the mosquito pest of the interior plateau.

AEDES FLAVESCENS (Muller)

Culex flavescens Muller, 1764. Fauna. Ins. Fried. p. 87

Aedes flavescens Dyar, 1922, Ins. Ins. Mens. 10:71

Female - A large, dull yellow species. Proboscis and palpi dark brown with scattered yellowish scales. Tori brown, with dark setae and yellow scales on the darker, inner surface. Mesonotum brownish yellow, with a broad median stripe of darker brown. Hypostigmal spot of many scales. Lower mesepimeral bristles absent. Abdomen clad in yellow scales. Wing scales yellow with a few brown ones intermixed. Tarsal segments mostly dark, with wide, basal, yellowish rings.

Larva - Antennae short, spiculate. Upper head hairs triple or multiple; lower, double or triple. Lateral abdominal hairs all double. Comb of segment VIII with 20-40 scales in a patch. Individual scale with a strong apical spine flanked by stout spinules. Pecten on basal two-fifths of air tube, sometimes with distal teeth widely spaced. Saddle of anal segment reaching two-thirds down the side of the segment. Gills about as long as the segment.

This is not a common mosquito in British Columbia, but has been taken at widely separated points. It is normally a mosquito of the open grasslands, but oddly enough, the first provincial record of the species was a capture high on Mt. Cheam, in the Coastal Range. (18) It bites viciously, but is rarely sufficiently numerous to constitute a pest.

AEDES HENDERSONI Cockerell

Aedes triseriatus var. hendersoni Cockerell, 1918. J. Econ. Ent. 11:199

Aedes hendersoni Breland, 1960, Ann. Ent. Soc. Amer. 53:600 For description, see A. triseriatus

This species was originally described by Cockerell as a variety of A. triseriatus from Wyoming. Breland raised it to full specific status on the strength of material from Colorado and Texas. It is found breeding in treeholes in association with triseriatus, but its full range is not yet known. It is mentioned here as a possible inhabitant of British Columbia although it has not yet been identified within the province.

AEDES HEXADONTUS Dyar

Aedes hexadontus Dyar, 1916. Ins. Ins. Mens. 4:83

Aedes cyclocerculus Dyar, 1920. Ins. Ins. Mens. 8:23

Aedes leuconotips Dyar, 1920. Ins. Ins. Mens. 8:24

Aedes hexadontus Knight, 1951. Ann. Ent. Soc. Amer. 44:93

Female - Proboscis and palpi dark. Tori uniformly dark, sometimes with a few pale scales. Mesonotum yellowish, with a broad, single or double, dark brown, median stripe. Sometimes with postero-lateral dark half-stripes. Prescutellar space paler yellow. Hypostigmal spot absent. Post-coxal scale patch present. Lower mesepimeral bristles one to three. Abdomen with basal white bands. Femora, tibiae, and proximal tarsal segments dark, sprinkled with pale scales. Distal segments all dark. Wing dark-scaled, with a patch of white scales at base of costa.

Larva - Antennae short, spiculate. Upper and lower head hairs usually double. Lateral abdominal hairs variable. Comb of segment VIII with 5-9 scales in a single row. Individual scale with a central thornlike spine, flanked by minute spinules. Pecten reaching less than half the length of the air tube; evenly spaced. Anal segment ringed by the saddle. Gills long, tapered.

Primarily a mosquito of the northern tundra, A. hexadontus nevertheless extends its range far down the cordillera, and out to the northern coast. The synonyms A. cyclocerculus and A. leuconotips were both described from Prince Rupert. The only other known British Columbia records are from Field, in the Rocky Mountains, and Tenquille Lake, in the Coast Range. The species is closely related to A. punctor, with which it may be easily confused, and is an avid daytime biter.

AEDES IMPIGER (Walker)

Culex impiger Walker, 1848. List Dipt. Brit. Mus. 1:6

Aedes nearcticus Dyar, 1919 (in part) Rept. Can. Arct. Exp. 3(c):32

Aedes alpinus Twinn, 1927. (in part) Can. Ent. 59:47

Aedes impiger Vockeroth, 1954. Can. Ent. 86:109

Female - Proboscis and palpi dark. Tori dark, with light scales on dorsal and inner surfaces. Mesonotum with brown scales centrally, anterior and lateral margins with yellowish scales. Numerous black setae give the mesonotum a hairy appearance. Hypostigmal spot absent. Post-coxal scale patch present. Lower mesepimeral bristles three to eight. Abundant setae on posterior half of postpronotum. Abdominal segments with broad, basal, white bands. Tarsi black. Hind tarsal claw abruptly bent beyond tooth. Tooth slender and three quarters length of claw. Wings dark-scaled, with a light patch at base of costa.

Larva - Antennae short, somewhat spiculate. Upper and lower head hairs single, long. Lateral abdominal hairs truple on segments I and II, double on III and IV, single on V and VI. Comb of segment VIII with 10-16 scales in a straggling double row. Individual scale with a thornlike central spine and short lateral spinules. Air tube about 3 x 1. Pecten evenly spaced on basal third, with a multiple tuft at or before the midpoint. Saddle of anal segment covering little more than half of sides. Gills usually long and pointed.

This is really an arctic mosquito, but is found at increasingly higher elevations in the Rocky Mountains as far south as Colorado. (8) It has been taken at Banff, and may be met with in the British Columbia Rockies and possibly in the Selkirks.

For many years this species was known as A. nearcticus until it was found that the type specimen of Culex impiger Walker was, in fact, an example of the species described by Dyar as nearcticus. Therefore, the older name was held to be valid, and must be used. Most early records of A. nearcticus and also A. alpinus will be found to refer to A. impiger, while some of the early impiger records should properly be labelled A. implicatus Vock.

Due to its restricted range, it will not be commonly encountered in this province, but where present, it is said to be an annoying pest.

AEDES IMPLICATUS Vock

Aedes impiger Dyar, 1920. (Not Walker, 1848) Ins. Ins. Mens. 8:8

Aedes implicatus Vockeroth, 1954. Can. Ent. 86:110

Female - Proboscis and palpi dark-scaled. Tori yellow to black, with a few white scales on inner surface. Mesonotum with a broad brown median stripe or paired stripes. Margins and prescutellar space grayish white. Hypostigmal spot present or absent. Post-coxal scale patch present. Lower mesepimeral bristles, one to three. Abdominal segments with basal white bands. Tarsi dark, with a few pale scales on the first segment. Wings dark-scaled, with a white patch at base of costa.

Larva - Antennae short, spiculate. Upper head hairs single or double; lower, single. Lateral abdominal hairs double on segments I to IV, single on V and VI. Comb on segment VIII of numerous scales in a patch. Single scale with a long central spine flanked by moderately long lateral ones. Air tube about 3 x 1. Pecten scales evenly spaced, not reaching midpoint of tube. Tuft inserted about midpoint. Saddle of anal segment reaching two-thirds down the side, spiculate towards apex. Gills long, pointed.

Records of this species, based on keys published prior to 1954 will be under the name A. impiger Dyar (39). Such records cover most of British Columbia east of the Coast range. However, the species has been found breeding in coastal marshes in Alaska, and may yet be taken on the British Columbia coast when more adequate collecting has been carried out in that area. It is a woodland mosquito, and bites vigorously in shaded situations during the day. It breeds in temporary snow- and rain-pools.

AEDES INCREPITUS Dyar

Aedes increpitus Dyar, 1916. Ins. Ins. Mens. 4:87

Aedes mutatus Dyar, 1919. Ins. Ins. Mens. 7:24

Aedes hewitti Hearle, 1923. Can. Ent. 55:5

Aedes increpitus Freeborn, 1926. Mosqu. of Calif. 395

Female - Proboscis dark. Palpi dark-scaled, with white tips to the segments. Tori brown, with a few white scales on the darker inner surfaces. Mesonotum with a borad, brown stripe surrounded by a mixture of brown and pale scales. No hypostigmal spot. Lower mesepimeral bristles one to five. Abdominal segments black, with basal white bands widening laterally. Tarsi with broad basal light bands on hind legs, narrower on mid- and forelegs. Wings brown-scaled, with scattered white scales inter-

mixed towards front.

Larva - Antennae short, spiculate. Upper head hairs usually double or triple; lower, single or double. Lateral abdominal hairs single or double. Comb on segment VIII with numerous scales in a patch. Individual scale fringed with several stout spinules apically and smaller ones at sides. Air tube about 3 x 1. Pecten evenly spaced on basal two-fifths of tube. Multiple tuft inserted beyond pecten. Saddle of anal segment covering three quarters of the side. strongly spiculate towards apex. Gills long, pointed.

This species is widespread and numerous in British Columbia, at the coast and throughout the interior, up to moderate altitudes. It is adapted to flood waters, irrigation seepages, rain-filled depressions and snowpools. It bites eagerly, and causes great annoyance in woods and shaded locations. It is considered to be a serious pest of cattle.

AEDES INTRUDENS Dyar

Aedes intrudens Dyar, 1919. Ins. Ins. Mens. 7:23

Female - Proboscis dark. Palpi dark, with a sprinkling of white scales. Tori yellowish on the outside, shading to brown on the inner surface. Mesonotum covered with brown scales, lighter toward the edges. Hypostigmal spot sometimes present. Lower mesepimeral bristles, none to five. Abdominal segments with broad, white, basal bands widening at the sides. Tarsi dark-scaled with a sprinkling of pale scales on the rear surface of the first segment. Wing scales dark brown, sometimes with a pale patch at the base of costa.

Larva - Antennae of medium length, spiculate, distally darker. Upper head hairs in 3 or 4; lower, double or triple. Lateral abdominal hairs single on most segments, sometimes double on I and II. Comb of segment VIII with 10 - 16 scales in a ragged double row. Individual scale with a large thornlike spine having a few minute spinules on the base. Air tube tapered, about 3 x 1. Pecten on basal half, with one or more distal teeth widely spaced. Multiple tuft distal to pecten. Saddle of anal segment extending well down the sides, with its ventral margin deeply indented. Gills long and pointed.

This is a typical woodland mosquito, and a great nuisance when encountered. Fortunately it is not one of our commoner

species. British Columbia records include the northern coastal region and the interior wet belt, where it breeds in woodland pools, bogs, and snowpools.

AEDES MELANIMON Dyar

Aedes melanimon Dyar, 1924. Ins. Ins. Mens. 12:126

Aedes klotsi Matheson, 1935. Proc. Ent. Soc. Wash. 35:69

Aedes melanimon Barr, 1955. Mosq. News 15(3):170

Female - Proboscis and palpi black with scattered white scales, and a cluster of white scales at the tip. Tori brown with white scales on the darker, inner surfaces. Mesonotum with a brown central band and posterior half-lines, separated from brown lateral areas by white lines. Hypostigmal spot of many scales present. Lower mesepimeral bristles, one to five. Pleural scales broad and spatulate. Abdominal segments with a narrow median line of white scales flanked by patches of black scales widening apically. White scales on sides and underneath. Tarsi with basal and apical white bands, segment V of hind leg almost all white. Tarsal claw with main tooth nearly straight in central section, lateral tooth slender and nearly parallel to main tooth. Wing with dark scales predominating, anal vein 6 almost all dark.

Larva - Upper and lower head hairs usually single. Lateral abdominal hairs on segments I and II double or triple; III to V double; VI, single. Comb of segment VIII of 15 - 30 scales in a patch, each scale with a strong central spine flanked by progressively smaller ones. Pecten not reaching middle of air tube. Multiple tuft just beyond the middle of the tube.

This species closely resembles A. dorsalis and is sometimes found in the same habitat, although generally preferring less saline waters. It is commonly encountered in irrigation waters, roadside ditches and sloughs. It was originally taken at high elevations in the southern Cordillera, but has more recently been collected at various levels, down to the sea at San Francisco. There are no records of its capture in British Columbia to date, but it has been taken at Brooks, Alberta, (7), and may eventually be found to occupy at least the southern portion of British Columbia. It has been suggested that most of the specimens found to be infected with encephalitis virus and attributed to A. dorsalis in the past were really A. melanimon.

AEDES NIGRIPES (Zetterstedt)

Culex nigripes Zetterstedt, 1840. Ins. Lapp. 807

Aedes alpinus Dyar (not Linnaeus), 1920. Ins. Ins. Mens. 8:53

Aedes nigripes Natvig, 1945. Norsk. Ent. Tidssk. 7:99-105

Female - Proboscis dark-scaled. Palpi short, sometimes with scattered pale scales. Tori black with grayish scales on upper and inner surfaces. Mesonotum covered with golden-brown scales, becoming paler at margins, and many dark hairs. Hypostigmal spot absent. Post-coxal scale patch present. Lower mesepimeral bristles one to five. Abdominal segments with broad, basal, white bands. Tarsi dark, with few pale scales on first segment. Hind tarsal claw long, and gently curved. Tooth less than half as long as claw, stout. Wing dark-scaled with a white patch at base of costa and veins 1 and 6.

Larva - Antennae short, spiculate. Upper and lower head hairs single. Lateral abdominal hairs single or double. Comb of segment VIII with scales in a ragged double row. Individual scale with a stout central thorn bearing minute spinules on the base. Pecten on basal half of air tube, with one or more distal teeth widely spaced, and the tuft inserted basad of the last tooth. Anal segment ringed by the saddle. Gills longer than the segment.

This is normally a mosquito of the northern tundra, and there is only one, somewhat doubtful, record from northern British Columbia. It is included here since the species may possibly be encountered in alpine meadows at high altitudes. Aedes nigripes bites fiercely, and when present in great numbers, as in the sub-arctic, constitutes a notable pest.

AEDES PIONIPS Dyar

Aedes pionips Dyar, 1919. Ins. Ins. Mens. 7:19

Female - Proboscis and palpi dark-scaled. Tori dark with pale scales on inner and upper surfaces. Mesonotum clothed with yellow to creamy scales, with paired bands of brown scales centrally, separated by a fine yellow line and flanked by posterior half-lines. Hypostigmal spot absent. Lower mesepimeral bristles,

one to four. Post-coxal scale patch present. Abdominal segments with basal white bands widening laterally. Tarsi dark-scaled. Wings dark-scaled, with a small patch of white at base of costa.

Larva - Antennae short, slender, spiculate. Upper and lower head hairs multiple. Lateral abdominal hairs double on segments I and II, double or single on III-IV. Comb of segment VIII of many scales in a patch. Individual scale with a fringe of similar spinules. Air tube 2.5 x 1, with a closely-spaced pecten on the basal third of the tube, and a multiple tuft before the middle. Saddle of anal segment reaching two-thirds down the sides. Gills long, pointed.

This is one of the very common mosquitoes of the northern forests, where it is closely associated with A. communis. The larvae breed in snow- and rain-pools and swamps, but develop more slowly than A. communis, emerging an average of two weeks later under similar conditions. In southern British Columbia, they are more likely to be found at higher elevations than in the valleys.

The adults are extremely difficult to separate from those of A. communis, but recently a reliable character has been found in the post-coxal scale patch, which occupies the membrane between the coxa of the front leg and the large sterno-pleural sclerite. This is present in A. pionips but not in A. communis. The species is of minor importance as a pest.

AEDES PULLATUS (Coquillet)

Culex pullatus Coquillet, 1904. Proc. Ent. Soc. Wash. 6:168

Aedes pullatus Dyar and Knab, 1906. H. N.Y. Ent. Soc. 14:201

Female - Proboscis black. Palpi black with scattered pale scales basally. Tori dark, with pale scales on the inner sides. Mesonotum with yellowish-brown scales, paler towards margins. A narrow, bare median line is bordered by two stripes of light brown scales, beyond which are two bare stripes. Some specimens have a pair of curving bare stripes on either side of the prescutellar space. Hypostigmal spot present. Lower mesepimeral bristles one to five. Post-coxal scale patch absent. Abdomen with basal white bands. First tarsal segments

dark, with scattered white scales intermixed. Remaining segments black. Wing dark-scaled, with patches of white at base of costa and veins 1 and 6.

Larva - Antennae short, slender, spiculate. Upper head hairs multiple; lower, in two to five. Lateral abdominal hairs usually triple on segment I, double on II-V, single on VI. Comb of eighth segment of many scales in a triangular patch. Each scale fringed with subequal spinules. Air tube about 3 x 1, with pecten teeth evenly spaced on basal third. Large tuft before the middle. Anal segment not ringed by the saddle. Gills long, pointed.

A woodland species, A. pullatus is chiefly confined to the mountains in southern British Columbia, but reaches lower levels in the north. It develops in snowpools and alpine meadow pools, and emerges rather later in the season than most other species. The females may be encountered at any time of day in the woods, and attack freely.

AEDES PUNCTOR (Kirby)

Culex punctor Kirby, 1837, in Rich. Faun. Bor-Amer. 4:309

Aedes punctor Dyar, 1919. Ins. Ins. Mens. 7:14

Female - Proboscis and palpi dark-scaled. Tori variable, from yellow to black, usually darker on inner surfaces. Mesonotum with yellow scales laterally, and a broad, dark-brown, median stripe or paired stripes, with postero-lateral half-stripes. Hypostigmal spot absent. Lower mesepimeral bristles one to five. Postcoxal scale patch present. Abdominal segments with basal white bands. Tarsal segments all dark. Wing scales dark, sometimes with a few white scales at base of costa.

Larva - Antennae short, spiculate. Upper and lower head hairs single or double. Lateral abdominal hairs double on first segment, single on segments II-VI. Comb of eighth segment with 10-20 scales in a straggling row. Single scale with a stout central thorn bearing small spinules on its base. Air tube 3 x 1. Pecten teeth evenly spaced. Multiple tuft about midpoint. Anal segment ringed by the saddle. (Sometimes closure is incomplete.) Gills long, tapered.

This is one of the dark-legged Aedes species that has proved difficult to pin down in the past, and it is possible that

many British Columbia records of A. punctor may actually refer to A. hexadontus. There is also a "tundra" form of punctor in which the mesonotum appears uniformly dark, but it is doubtful if this will be found in British Columbia. A. punctor is a snowpool mosquito of the mountains and forests. It is a serious pest of man and animals in wooded area.

AEDES PUNCTODES Dyar

Aedes punctodes Dyar, 1922. Ins. Ins. Mens. 10:1

Female - Indistinguishable from the "tundra" type of A. punctor.

Larva - Similar to that of A. punctor except that the lower head hairs are single, and the saddle of the anal segment does not quite encircle it.

This is quite commonly regarded as a subspecies or variant of A. punctor, but it has been shown to be reproductively isolated from that species. It is reported only from the coast and river valleys of Alaska, as far south as Juneau. It may possibly occur on our northern coast, or up such rivers as the Stikine or Naas.

AEDES RIPARIUS Dyar and Knab

Aedes riparius Dyar and Knab, 1907. J. N.Y. Ent. Soc. 15:213

Female - Proboscis black, with brown scales about the middle. Palpi black, with white scales at the tips of the segments. Tori brownish, darkening on the inner surfaces, which carry a number of dark scales and sometimes a few pale ones. Mesonotum with the central area covered with golden-brown scales, becoming paler at the margins. Hypostigmal scale patch present. Post-coxal patch of few to many scales present. Lower mesepimeral bristles absent. Abdominal segments with white basal bands, and a few white scales in dark areas. Tarsal segments with basal white bands, broader on the hind legs. Wings mainly dark-scaled, with some white intermixed.

Larva - Antennae short, spiculate, narrowed beyond the tuft, which is inserted before the middle of the shaft. Upper and lower head hairs long, double. Lateral abdominal hairs usually double, sometimes single on posterior segments. Comb of eigth segment an irregular double row. Single scale with a prominent terminal spine with small spinules flanking the base. Air tube 3.5 x 1.

Pecten with closely spaced teeth on basal quarter, then three or four teeth spaced out to two-thirds of tube. Small tuft beyond the last tooth. Anal segment not ringed by the saddle. Ventral margin of the saddle irregular. Ventral brush well developed. Gills long, pointed.

The occurrence of A. riparius in British Columbia was formerly thought to be confined to the Peace River country, east of the Rocky Mountains. It has recently turned up in the Cariboo area, and more intensive collecting may show it to be more widespread in the province than was formerly thought to be the case. This species inhabits open parkland, where tree-shaded pools are available. The females are reported to bite by night or day.

AEDES SIERRENSIS Ludlow

Taeniorhynchus sierrensis Ludlow, 1905. Can. Ent. 37:231

Aedes varipalpus Howard, Dyar, and Knab (nec Coquillet) 1917, Mosqu. No. & Cent. Amer. and W.I. 4:644

Aedes sierrensis Belkin and McDonald, 1956. Proc. Ent. Soc. Wash. 58:344

Female - A small species. Proboscis dark-scaled. Palpi short, dark, with white at tips of segments and a conspicuous terminal tuft of white. Tori dark, with numerous white scales on inner and dorsal surfaces. Mesonotum with a central stripe and curved lateral lines of golden scales on a background of curved dark brown scales. Hypostigmal spot and lower mesepimeral bristles absent. Abdominal segments with strongly contrasting white basal bands, widest at the centre, narrowing laterally. Tarsal segments ringed apically and basally with white: hind segment 5 entirely white. Wing scales dark, with a patch of white at base of costa.

Larva - Antennae short, smooth. Antennal tuft consisting of a single hair inserted beyond the middle. Upper and lower head hairs single or double. Lateral abdominal hairs commonly double on segments I-V, sometimes triple on I-III: single on VI. Comb of segment VIII consists of a double row of scales, each scale evenly fringed with small spinules. Air tube about 3.5 x 1, with the pecten on the basal fourth. Multiple tuft inserted before the middle. Anal segment with a relatively small saddle. Lateral hair much longer than the saddle. Gills long and broad, bluntly rounded.

This is one of the few species that breed characteristically in treeholes, although sometimes it will be found in artificial containers in which the water has a high organic content. It is reported that the eggs laid late in the summer hatch in the fall, and the winter is spent in the larval stage. Due to its breeding habit the species is not widespread in the province, but may be locally abundant, in which case it may be troublesome. The males have the habit of lurking near warm-blooded animals, where they may seize and mate with the females that approach for a blood meal.

AEDES SPENCERII (Theobald)

Culex spencerii Theobald, 1901, Mon. Culic. 2:99

Grabhamia spencerii var. idahoensis Theobald, 1903, Mon. Culic. 3:250

Aedes spenceri (sic.) Dyar, 1907, Proc. U.S. Nat. Mus. 32:125

Aedes idahoensis Howard, Dyar, & Knab, 1917, Mosq. No. and Cent. Amer. and W.I. 4:727

Aedes spencerii Pratt, 1956, Mosqu. News 16(1):4

Female - A highly variable species. Proboscis dark-scaled; palpi speckled with white. Tori mainly black, with light scales on inner and dorsal surfaces. Mesonotum generally with a broad central stripe of brown scales, sometimes divided by a narrow median grey stripe and sometimes bordered by pale posterior half-stripes. Lateral areas with whitish scales. Scutellum with golden setae and yellowish-white scales. Mesepimeron covered with scales to near lower margin; lower mesepimeral bristles absent. Abdominal pattern variable from basal white bands, sometimes with a central white stripe, to almost completely white-scaled. Tarsi unbanded, but with pale scales on posterior surfaces. Wing with veins pale-scaled, except for costa and veins 1, 3, and 5 which have dark scales.

Larva - Antennae short, spiculate, with a multiple tuft near middle that reaches almost to the tip. Upper and lower head hairs single, or rarely with one double. Thorax and abdomen spiculate. Lateral abdominal hairs triple on segment I, double on II and III, single on segments IV-VI. Comb of eighth segment of 7-30 scales in a ragged double row. Comb scales gradually tapering from base to a long central spine with small to minute

spinules on the basal part. Air tube short and stout with pecten reaching to, or slightly beyond, the middle; last 2 or 3 pecten teeth more widely separated. A tuft of 2-4 short hairs inserted just beyond the pecten. Lateral hair of anal saddle shorter than the saddle. Gills long, pointed.

This species has two distinct forms which were formerly considered to be of specific rank. That originally known as spencerii is the typical and almost dominant species of the prairie grasslands, while the idahoensis form inhabited the wooded and mountainous country of Montana, Idaho, eastern Washington and southern British Columbia. Further south, however, the two merged and became indistinguishable. There are numerous records of A. idahoensis from southern British Columbia, while the only capture of the spencerii form within our boundaries was made in the Peace River country, east of the mountains. Consequently it may be expected that most future records will involve the idahoensis type, with banded abdomen and will emanate from the southern part of the province.

This species breeds in a wide range of waters, including snowpools, rain pools, irrigation seepages, and floodwaters. It has been taken at Kamloops in association with A. vexans and elsewhere along with A. dorsalis. It may produce more than one brood per season, is a fierce biter, and when present in large numbers, forms a serious pest. Fortunately, it is nowhere very common in British Columbia.

AEDES STICTICUS (Meigen)

Culex sticticus Meigen, 1838. Syst. Beschr. Zweifl. Ins. 7:1

Aedes aldrichi Dyar and Knab, 1908. Proc. U.S. Nat. Mus. 25:57

Aedes lateralis (Meigen), 1932. Edwards, in Wytsman, Gen. Ins. 194:144

Aedes sticticus King, Bradley and McNeel, 1939. Mosq. S.E. States:48

Female - Small. Proboscis and palpi dark-scaled. Tori yellow outwardly, darker, with pale scales, on inner surface. Mesonotum with paired golden brown median stripes and postero-lateral half stripes on a background of narrow, pale yellow scales. Hypostigmal spot and lower mesepimeral bristles absent. Abdominal

segments with narrow, basal, white bands broadening laterally. Tarsal segments unbanded, but a few pale scales among the black. Wing scales dark. White patch sometimes present at base of costa.

Larva - Antennae short, spiculate, with a multiple tuft before the middle. Upper head hairs 2-4 branched; lower, 1-3 branched. Lateral abdominal hairs double on segments I-VI. Comb of eighth segment 20-25 scales in a triangular patch, each with a strong central spine flanked by a pair of fairly stout spinules, remaining spinules much smaller. Air tube short and stout, with a closely-spaced pecten on the basal third. Multiple tuft beyond the pecten. Saddle of anal segment extending well down the side. Gills long, pointed.

This species has not, so far, been reported north of the Skeena-Nechako line, but in the southern portion of our province constitutes one of our most serious pests. It is a floodwater breeder, and develops most commonly in timbered river flats. Hatching takes place immediately after the peak of a freshet, which occurs generally in late May or early June. It sometimes happens that a river will develop several peaks at internals of a week or so, and each peak will produce a fresh brood of sticticus, thus complicating control measures. A. sticticus readily invades homes, has a flight range of several miles, and is a vicious biter by day or night. It was discussed by Hearle in his report on the Fraser Valley mosquitoes under the name A. aldrichi.

AEDES STIMULANS (Walker)

Culex stimulans Walker, 1848. List Dipt. Brit. Mus. 1:4

Aedes stimulans Howard, Dyar, and Knab, 1917. Mosqu. No. and Cent. Amer. and W.I. 4:679

Female - Proboscis and palpi dark-scaled, with scattered white scales. Tori yellow on lateral surfaces, darkening on inner sides, which may bear a few white scales. Mesonotum generally with a broad central stripe of brown scales on a background of cream to light-brown scales. Hypostigmal spot lacking. Lower mesepimeral bristles, two to four. Abdominal segments with broad, pale, basal bands, and some pale scales at apices of posterior segments. Tarsal segments with basal white rings, broader on hind legs. Wings dark-scaled, with some scattered white along costa.

Larva - Antennae short, spiculate, with tuft near centre. Upper head hairs double; lower, single. Lateral abdominal hairs triple on segment I, double on II-V, single on VI. Comb of segment VIII of many scales in a patch, each scale with a central spine flanked by progressively smaller ones. Air tube 3.5 x 1, with a closely-spaced pecten on the basal half. Tuft of 3-4 hairs about mid-point. Anal segment not ringed by the saddle. Gills about as long as the saddle, bluntly pointed.

This is one of the most abundant and annoying mosquitoes in the woods of eastern and northern Canada, but appears to be relatively uncommon in British Columbia, although it has been reported in various places from the United States border to the Yukon. It breeds in woodland pools and shaded floodwaters, and survives until well into late summer.

AEDES TRICHURUS (Dyar)

Culex trichurus Dyar, 1904. J. N.Y. Ent. Soc. 12:170

Aedes trichurus Howard, Dyar and Knab, 1917. Mosqu. No. and Cent. Amer. and W.I. 4:759

Female - Proboscis and palpi dark-scaled. Tori brown on outer surface, darker inwardly, with pale scales. Mesonotum grayish-white with a broad brown stripe becoming wider posteriorly. Hypostigmal and post-coxal scale patches present. Lower mesepimeral bristles three to six. Abdominal segments with basal white bands widening laterally. Tarsal segments dark-scaled. Wing with brown scales, a patch of white at base of costa.

Larva - Antennae short, sparingly spiculate. Upper head hairs double or triple; lower, single. Lateral abdominal hairs triple on segment I, double on II and III, single on IV-VI. Comb of segment VIII in a ragged double row, each scale with a thornlike spine flanked by basal spinules. Air tube about 3 x 1. Pecten extending over three fourths of the tube, with the outer four or five teeth more widely spaced. Large tuft inserted within the pecten, and several small dorso-lateral tufts present. Anal segment not quite ringed by the saddle. Gills long, pointed.

This is a woodland, snowpool species, rarely taken in British Columbia. It is doubtful if it occurs anywhere in the province in sufficient numbers to constitute a nuisance, although the females bite avidly.

AEDES TRISERIATUS (Say)

Culex triseriatus Say, 1823. J. Acad. Nat. Sci. Phila. 3:12

Aedes triseriatus var. hendersoni Cockerell, 1918 J. Econ. Ent. 11:109

Female - Proboscis and palpi black. Tori brown with fine, dark setae on inner surfaces. Mesonotum with a broad, brown median stripe widening towards the rear. Sides and anterior margin with white scales. A few white scales at anterior end of the prescutellar space, which is flanked by long, golden setae. Hypostigmal and post-coxal scale patches absent. Lower mesepimeral bristles absent. Abdominal segments with white laterobasal patches. Tarsal segments lacking white bands. Wings dark-scaled.

Larva - Antennae short, smooth. Tuft represented by a single hair. Upper head hairs single; lower, double to 4-branched. Lateral abdominal hairs double or triple on segments I and II, double on II-VI. Comb of segment VIII in a double row, each scale long and narrow, evenly fringed with minute spinules. Air tube 3 x 1, with the pecten reaching nearly to the middle. Single or double hair inserted beyond the pecten. Anal segment not ringed by the saddle. Small multiple tuft on apical margin of saddle. Gills bluntly rounded, dorsal pair longer than ventral pair.

This species has been taken in British Columbia only once, at Vernon, in 1921. It is a treehole breeder, and therefore the larvae will not be found unless sought for in their limited habitat. The females are said to be persistent biters, and the bite to be very painful. A. triseriatus and A. hendersoni closely resemble each other, but there are consistent differences in both adult female and larva. In adults of A. hendersoni the brown stripe on the mesonotum does not approach the anterior margin, and is divided wholly or partly down the middle by a narrow line of white scales. In the larval stage, hendersoni is almost white, while triseriatus is almost completely black. The saddle of the anal segment is much reduced in hendersoni, reaching less than halfway down the side, and covering only half the dorsal length. The lateral hair of the segment is usually double instead of multiple as in triseriatus, and is often inserted beyond the margin of the saddle. The dorsal and ventral pairs of gills are of about equal length.

Breland (5) who established the specific status of hendersoni suggests that the true triseriatus is the form found in the eastern and southern states, and that hendersoni is the western representative of the complex. The Vernon specimen clearly shows the triseriatus pattern on the mesonotum, and must be considered to belong to that species, although hendersoni has been taken as near to this region as Idaho (30). Many more British Columbia specimens are required to clear the matter up with certainty.

AEDES VEXANS (Meigen)

Culex vexans Meigen, 1830. Syst. Beschr. Zweifl. Ins. 6:241

Aedes vexans Blanchard, 1905. Les Moustiques Paris p. 309

Female - Proboscis dark-scaled. Palpi short, dark, with pale scales at both ends of segment IV. Tori brown, with a few pale scales. Mesonotum clad in golden-brown scales, paler near margins. Hypostigmal scale patch, post-coxal scale patch, and lower mesepimeral bristles absent. Abdominal segments with basal white bands indented centrally and narrowed laterally. Tarsal segments with narrow basal white bands. Wing scales dark. (See cover illustration)

Larva - Antennae short, spiculate. Upper head hairs multiple; lower, double or triple. Lateral abdominal hairs on segments I-V double or triple. Comb of segment VIII with 9-12 scales in an irregular row, each scale consisting of a central thorn with marginal spinules along its base. Air tube 3.5 x 1. Pecten covering half the tube, with the last two or three teeth more widely spaced. Small tuft inserted beyond the pecten. Anal segment not quite ringed by the saddle. Gills long, pointed.

Every summer the rivers of British Columbia rise in freshet and cover the nearby flats to a greater or lesser extent. Aedes vexans develops in these floodwaters in enormous numbers and constitutes our greatest mosquito problem. Not all eggs hatch at the first flooding, and since the rivers may rise to several successive peaks in any one season, each initiating a further hatch, the problem requires close vigilance by control workers. The resulting mosquitoes have a long flight range, variously reported as extending up to 10 or 20 miles, and to be effective, control measures must be planned accordingly.

CULEX PEUS Speiser

Culex peus Speiser, 1904. Insekten-borse 21:148

Culex stigmatosoma Dyar, 1907. Proc. U.S. Nat. Mus. 32:123

Culex peus Stone, 1958. J. Kans. Ent. Soc. 31:236

Female - Like that of C. tarsalis except that the femora and tibiae lack the white lines or rows of dots that characterize the latter.

Larva - Resembling tarsalis except that the dorso-apical portion of the saddle on the anal segment is furnished with an array of conspicuous dark spicules that are lacking in tarsalis.

This species has not so far been taken in British Columbia, but is produced in great numbers in log ponds in Oregon and parts of Washington. It is mentioned here in view of the possibility that it may extend its range into the lower mainland of this province. It is said to feed on man but rarely.

CULEX PIPIENS L.

Culex pipiens Linnaeus, 1758. Syst. Nat. Edn. 10:602

Female - Proboscis and palpi dark. Tori uniformly dark brown. Mesonotum covered with golden-brown scales. Abdomen black with basal pale bands widest on the centre line and narrowing laterally to join with triangular lateral scale patches. Tarsal segments without pale bands. Wings dark-scaled.

Larva - Antennae long, spinose, with the distal third, beyond the tuft, constricted. Upper and lower head hairs multiple. Lateral abdominal hairs multiple on segments I and II, double on III-VI. Comb of eighth segment of numerous scales in a triangular patch, each scale slipper-shaped and fringed with small spinules. Air tube 4 or 5 x 1, with the pecten on the basal fourth. Four pairs of tufts inserted beyond the pecten, with the third pair slightly out of line, and placed more dorsally. Anal segment ringed by the saddle. Gills long, pointed.

This introduced species has spread widely and increased in numbers enormously in recent years, and is now common from Vancouver Island at least as far east as the Okanagan Valley.

The females, bent on hibernation indoors, cause considerable alarm to housewives when they invade homes in the fall. At this time they have no interest in a blood meal and do not bite. Whether they take human blood at all is at present a moot point.

On emergence from hibernation the fertilized females seek a blood meal, probably from birds, and soon lay their eggs in boat-shaped rafts on the surface of water in old cans, water-troughs, old tires, dairy drains, and sometimes in open swamps. The new generation matures, mates, and lays its eggs in three to five weeks, and several generations may pass in one season, depending for their number upon the average warmth of the summer. In the fall the males die off and the females carry the species through another winter.

The exact status of the Pacific northwest population of the Culex pipiens complex is still uncertain, and must remain so until its feeding habits and physiology are better understood. Some strains of the complex are autogenous, i.e. they can lay eggs without having taken a blood meal. Some will lay one batch autogenously, and then require blood before producing a second. Others are entirely non-autogenous. In various parts of the continent pipiens has been shown to carry the causative organisms of avian malaria, heartworm of dogs, fowl pox, and both western and St. Louis strains of equine encephalomyelitis.

CULEX TARSALIS Coquillet

Culex tarsalis Coquillet, 1896. Can. Ent. 28:43

Female - A mosquito of medium size. Proboscis with a broad white ring. Palpi tipped with white. Tori with numerous white scales on inner surfaces. Mesonotum covered with fine brown scales; a fine line of white scales extending forward each side of the prescutellar space, and terminating in a white spot. Abdominal segments with basal white bands, except that the first has scattered pale scales, and the second, a basal, triangular patch. Wing scales dark except for a few pale ones near base of costa. Legs brown scaled, with basal and apical white bands on all tarsal segments except 4 and 5 on front and middle legs; a prominent white line or row of white spots laterally on hind femur and tibia.

Larva - Antennae shorter than the head, strongly spiculate to insertion of the large tuft. Dark at base and apex, pale between. Upper and lower head hairs multiple. Lateral abdominal hairs triple on segments I-V, double or triple on VI. Comb on segment VIII of many scales in a patch, each scale rounded apically and fringed with subequal spinules. Air tube about 5 x 1, with a pecten of 10-15 teeth on basal third. Five pairs of tufts beyond the pecten with none out of line. Anal segment ringed by the saddle, gills longer than saddle, bluntly pointed.

In British Columbia Culex tarsalis is common from the coast to the Okanagan Valley, and has been taken as far north as Little Fort on the North Thompson. The lack of records from the Kootenays is probably due to the paucity of collections from that area, and the species may also turn up in the Cariboo. It breeds in a wide variety of waters, such as flooded meadows, irrigation seepages, borrow pits and sewage lagoons, and can tolerate a high degree of pollution. The females hibernate in the crevices of rock slides, in rodent burrows, culverts, and cellars. Egg-laying commences in early summer, and there may be several generations in a single season.

In the Columbia Basin of Washington and on the prairies, Culex tarsalis is considered the principal vector of western equine encephalomyelitis, and it has also been found to carry the viruses of St. Louis, Japanes B, and California encephalitis. In British Columbia it remains only a potential threat to health. Sporadic cases of sleeping sickness in horses have occurred, but to date there has been no authenticated human incidence of this disease.

Birds form the preferred source of blood for this species, but the females will enter houses at night and can inflict a very painful bite.

CULEX TERRITANS Walker

Culex territans Walker, 1856. Ins. Sound. Dipt. I:428
Culex apicalis of authors, not Adams
Culex territans Bohart, 1948. Ann. Ent. Soc. Amer. 41:332

Female - A very small mosquito. Proboscis long, brown-scaled. Palpi short, black. Tori brown with a few white scales medio-dorsally. Mesonotum covered with pale brown scales having a pair of indefinite pale spots near the centre, and two indistinct submedian

bare lines. Abdominal segments with narrow apical white bands, widening at the sides into triangular patches. Wing scales black. Tarsi unbanded.

Larva - Antennae as long as the head, spiculate to the constriction, where a large tuft is inserted. Upper and lower head hairs usually single, but occasionally double or triple; the upper shorter than the lower. Lateral abdominal hairs triple on segments I and II, double on III-VI. Comb of eighth segment of many scales in a patch. Air tube 6 x 1, tapering to near the end, with a slight apical flare. Pecten on basal third, with five pairs of tufts beyond, not always in line. Anal segment ringed by the saddle, which is strongly spiculate dorso-apically. Gills variable, but usually short.

Early records of C. apicalis Adams properly refer to territans, since the former is now known to be confined to California and Arizona. Territans breeds in permanent pools and swamps, grassy ditches and borrow pits, but does not develop in polluted water. It is not very common in British Columbia, and does not bite man, preferring to draw its blood meals from amphibians.

CULISETA ALASKAENSIS (Ludlow)

Theobaldia alaskaensis Ludlow, 1906. Can. Ent. 38:326

Culiseta alaskaensis Howard, Dyar, and Knab, 1915. Mosq. No. and Cent. Amer. and W.I. 3:498

Female - Proboscis dark, with scattered white scales on basal part. Palpi short, dark, with scattered white scales. Tori brown, with yellowish scales on darker inner surface. Mesonotum mainly brown-scaled, with scattered white ones present; a suggestion of paired median spots. Abdominal segments dark, with broad basal white bands. Tarsal segments with basal white bands, broader on the hind legs. Wings mainly dark-scaled, with scattered white on costa, sub-costa, and vein 1. Dark scales congested to form spots as follows: at root of vein 2, on the cross-veins, at the forks of veins 2 and 4, and middle of 6. Cross-veins 3-4 and 4-5 separated by less than the length of either.

Larva - Antennae short, spiculate. Upper head hairs multiple; lower, in 3 or 4, longer than upper pair. Lateral abdominal hairs triple on segments I and II, double on III-VI. Comb of eighth seg-

ment of many scales in a patch, each scale evenly fringed with spinules. Air tube about 3 x 1. Pecten on basal fifth of tube, followed by a row of long hairs to beyond the midpoint. Anal segment ringed by the plate, with one or more tufts of the ventral brush piercing the chitin. Anal gills long, pointed.

This species is widespread through the western and northern parts of the province, but is nowhere very numerous. The females bite in the shade, but rarely form any significant part of the mosquito pest. The winter is spent in sheltered spots by the females, who emerge in the spring to seek a blood meal and develop their eggs. These are laid on the surface of the water in pools or ditches with a good deal of emergent vegetation. Under favourable conditions there may be several broods during a season.

CULISETA IMPATIENS (Walker)

Culex impatiens Walker, 1848. List Dipt. Brit. Mus. 1:5

Culiseta impatiens Howard, Dyar, and Knab, 1915. Mosq. No. and Cent. Amer. and W.I. 3:483

Female - Proboscis and palpi dark, with a few scattered white scales. Tor. brown, sometimes with a few pale scales on the darker inner surfaces. Mesonotum with mingled brown and yellowish scales, a pair of yellowish lines extending posteriorly from paired pale spots. Abdominal segments black with basal white bands. Tarsal segments unbanded. Wing scales dark, forming clusters at forks of veins 2 and 4 and bases of veins 2 and 3. Cross-veins without scales, and separated by less than their own length.

Larva - Antennae short, spiculate, with multiple tuft near midpoint. Upper and lower head hairs multiple and of equal length. Lateral abdominal hairs multiple on segments I and II, double on III-VI. Comb of eighth segment of many scales in a patch, each scale fringed with equal spinules. Air tube 2.5 x 1, with a short pecten near the base, followed by a row of hairs reaching to the apical fourth of the tube. Large multiple tuft inserted within the pecten near the base. Anal segment ringed by the saddle. Gills long, pointed.

This is one of the less important mosquitoes in the province. The females emerge from hibernation early in the spring and oviposit in deep and shaded woodland pools. They are not aggressive biters, and while they will attack man on occasion, they prefer blood from other mammals, chiefly cattle. There may be several generations in a favourable season.

CULISETA INCIDENS (Thomson)

Culex incidens Thomson, 1868. Kongl. Sven. Frg. Eug. Resa. 6, Dipt. :443

Culiseta incidens Felt, 1904. Bull. 79, N.Y. State Mus. 391c

Female - A large mosquito. Proboscis and palpi dark, with scattered white scales. Tori brown with white scales on inner surfaces. Mesonotum with an obscure pattern of golden scales among dark brown ones. Abdominal segments dark, with basal bands of yellowish scales. Tarsi with narrow basal bands, less distinct on forelegs. Wing scales dark, aggregated into clusters on veins, 2, 4, 5, and 6. Cross-veins bare, separated by less than the length of either.

Larva - Antennae short, with few spcules, mainly on basal part. Upper and lower head hairs multiple, the upper pair with more branches. Lateral abdominal hairs multiple on segments I and II, double on III-VI. Comb of eighth segment of many scales in a patch, each scale fringed with equal spinules. Air tube 3 x 1, with a short pecten of 10-15 teeth followed by a row of hairs reaching to the outer fourth of the tube. Tuft multiple, inserted within the pecten.. Anal segment ringed by the saddle. Gills long, pointed.

The larvae of Culiseta incidens occupy a wide range of waters, but are commonly found in artificial containers, garden pools, and polluted waters, as well as in shaded woodland pools. In British Columbia the females hibernate, to emerge in early spring, when, partly on account of their large size, they generate consternation out of all proportion to their importance. They are generally not aggressive biters, and prefer large mammals to man as a blood source. There is some evidence for the existence of two forms of C. incidens, one of which does not bite man at all. For reasons that are not at present clear, populations of this species are greater in spring and fall than at the peak of the summer.

CULISETA INORNATA (Williston)

Culex inornatus Williston, 1893. U.S. Dept. Agr. Divn. Ornith. & Mam., No. Amer. Fauna 7:253

Culiseta inornatus Dyar, 1907. Proc. U.S. Nat. Mus. 32:123

Female - A large mosquito. Proboscis and palpi dark, with scattered pale scales. Tori dark brown with a few white scales on the inner surfaces. Mesonotum covered with mixed light brown and yellow scales. Abdominal segments with basal bands of yellowish-white scales widening at the sides to become continuous from segment to segment. Tarsal segments unbanded. Wing scales dark, and sparse on all but anterior veins, where some white scales are intermixed. Cross-veins separated by less than the length of either.

Larva - Antennae short, sparsely spiculate. Upper and lower head hairs both multiple, but the upper has more branches and is shorter than the lower. Lateral abdominal hairs multiple on segments I and II; double on III-VI. Comb of eighth segments of many scales in a patch, each scale fringed with spinules. Air tube 3 x 1, with a short pecten followed by a row of hairs extending to near the apex. A large tuft lies within the pecten, near the base of the tube. Anal segment ringed by the saddle, which is pierced by one or two tufts of the ventral brush. Gills about equal to the segment, rounded at the tips.

This mosquito is found in all parts of the province, but is nowhere very numerous. Since the adults prefer blood from larger mammals to that of man, they may escape notice, even when present. They are most commonly observed when emerging from hibernation in early spring, or when attracted to lights. They have been seen in flight in weather too cold for almost any other insect. The larvae develop in a wide range of waters, including irrigation seepages, highly polluted waters, and artificial containers. When locally numerous the adults may pester cattle seriously, and they have also been shown to be vectors of encephalitis virus. However, since they rarely bite humans, they are not regarded as a menace in this respect.

CULISETA PARTICEPS (Adams)

Culex particeps Adams, 1903. Kans. Univ. Sci. Bull., Ser. 2. 2:26

Culiseta maccrackenae Dyar and Knab, 1906. Proc. Biol. Soc. Wash. 19:133

Culiseta particeps Stone, 1955. K. Kans. Entom. Soc. 31:326

Female - Proboscis and palpi dark-scaled with a scattering of pale scales. Palpi with white tips and white bands on segments. Tori brown with pale scales on inner surfaces. Mesonotum mostly covered with dark brown scales, with a scattering of paler ones forming an indefinite central stripe and posterior half-lines; paler scales at margins and in prescutellar space. Abdominal segments with basal white bands, somewhat broadened medially. Femora brown with scattered pale scales aggregated into a pre-apical white ring. Tarsal segments with basal white bands. Wing scales brown, with a few white intermixed on the anterior veins. Cross-veins with scales, separated by less than the length of either. The dark scales are aggregated to form prominent spots at base and forks of vein 2, at cross-veins, at base of 5, and apical end of 6.

Larva - Antennae short, sparingly spiculate. Upper and lower head hairs multiple; the upper with more hairs. Lateral abdominal hairs multiple on segments I and II, double on III-VI. Comb of segment VIII of numerous scales in a triangular patch, each scale evenly fringed with spinules. Air tube 3 x 1. Pecten on basal fourth of siphon, followed by a row of hairs reaching to the apical fourth. Multiple tuft near the base of the tube. Anal segment ringed by the saddle, which has a spinose area on the dorso-apical aspect. Gills long, pointed.

This species has not been taken in British Columbia, with the exception of one rather doubtful record in the Fraser Valley. However, it is present in Oregon and Washington, and is included here in view of the possibility that its range may extend northward at some future date. Within its known range Culiseta particeps rarely occurs in sufficient numbers to be troublesome, and the larvae are very timid, hiding beneath the bottom vegetation at the least sign of disturbance. Thus they are found only after a determined search. They most commonly occur in shady pools with a bottom layer of dead leaves.

CULISETA MINNESOTAE Barr

Culiseta minnesotae Barr, 1957. Proc. Ent. Soc. Wash. 59:163

Female - Proboscis dark brown, with scattered pale scales about the middle. Palpi dark brown, paler towards tip. Tori light brown with a few dark scales on the medio-dorsal surface. Mesonotum clad in coppery-brown scales with lines of dark bristles. Paired small patches of silvery scales lie ahead of the prescutellar space and are joined to it by paired silvery lines with silvery scales between them. Lower mesepimeral bristles, 3. Abdominal segments mainly pale-scaled, with median brown patches. Tarsi dark, with basal and apical light rings on at least the first two segments. Wings brown-scaled with some pale ones on base of costa. Outer portion of costa with a yellowish fringe. Dark scales somewhat aggregated at base of vein 3.

Larva - Antennae long, strongly spiculate on basal two-thirds. Apical third constricted beyond the insertion of a multiple tuft. Upper head hairs multiple; lower, double or triple and twice as long as upper. Lateral abdominal hairs multiple on segments I and II, single on III-VI. Comb of 8th segment of 50-100 scales in a patch, each scale expanded apically and fringed with subequal spinules. Air tube 7 x 1, with a small pecten on the basal fourth having the distal teeth widely separated. Pecten is not produced into a row of hairs. Basal tuft inserted within the pecten. Anal segment longer than wide, ringed by the saddle. Ventral brush of not more than 19 tufts. Gills as long as the saddle, pointed.

This species is closely related to C. morsitans and many records of morsitans prior to 1957 will be found to refer actually to minnesotae. The specimens of morsitans in the Kamloops collection have been examined and found to be correctly designated, but minnesotae have been taken near our borders and may yet be found within the province (31). Not much is yet known of its habits, whose clarification awaits the accumulation of more detailed observations. It does appear, from the condition of spring-caught females, that they hibernate in the adult stage. Larvae have been taken in water described as "stagnant, swampy," and in the overflow from a well.

CULISETA MORSITANS (Theobald)

Culex morsitans Theobald, 1901. Mon. Culic. 2:8

Theobaldia dyari Hearle, 1927. Proc. Ent. Soc. B.C. 24:11

Culiseta morsitans Matheson, 1944. Hdbk. Mosqu. No. Amer. Ed. 2:224

Female - Proboscis and palpi dark-scaled. Tori brown with brown setae on the inner surfaces. Mesonotum brown, with yellowish scales toward margins. A pair of indefinite bare median lines and postero-lateral half-lines are usually present. Abdominal segments clothed with bronzy-brown scales, with scattered yellowish ones that may become aggregated into basal bands. Tarsal segments dark, with faint pale rings at both ends. Wings dark-scaled, with some white at base of costa. Cross-veins bare and separated by a space greater than the length of either.

Larva - Antennae long, curved, spiculate, with a large multiple tuft at about the outer fourth of the shaft. Upper head hairs multiple, of moderate length. Lower head hairs double, and very long. Comb of eighth segment of many scales in a patch, each somewhat expanded apically, and fringed with spinules. Air tube about 6 x 1, with a few pecten teeth on the basal fifth, the distal ones more widely spaced. A tuft of four or five hairs lies near the base. Anal segment longer than wide, ringed by the saddle. Ventral brush or twenty or more tufts. Gills long, pointed.

This is a mosquito of fairly northern distribution, and though widely scattered through the province, is rarely taken. The eggs are said to be laid on the surface of damp ground, like those of Aedes. The winter is passed in the larval stage. The females rarely, if ever, bite man.

MANSONIA PERTURBANS (Walker)

Culex perturbans Walker, 1856. Ins. Saund Dipt. :428

Culex testaceous Van der Wulp, 1867. Tids. voor Ent. (2) 10:128

Mansonia perturbans Dyar, 1909. Proc. Ent. Soc. Wash. 9:145

Female - Proboscis dark, with a broad ring of pale scales about the middle, and scattered pale scales on the basal part. Palpi short, dark, with a few scattered pale scales. Tori brown, with

a few pale scales on the darker inner surface. Mesonotum thinly covered with brownish to pale yellow scales. Often the integument will show a pair of silvery-pruinose longitudinal lines. Abdominal segments dark-scaled, with pale baso-lateral patches which may join to form continuous narrow basal bands. Legs with mixed light and dark scales; hind tibia with a light ring near apex. First tarsal segments with a narrow basal ring and a broader one near the middle; remaining segments with very broad basal rings. Wings with broad scales, light and dark mixed.

Larva - Antennae long and somewhat sinuous, having a large multiple tuft and a pair of short setae somewhat distal to the tuft. Upper head hairs multiple, small. Lower head hairs multiple and much larger. Lateral abdominal hairs single on all segments. Comb of eighth segment a ragged single row, each scale thorn-shaped, with fine lateral spinules on the basal part. Air tube conical, with the distal part heavily sclerotized and serrated. In a sub-apical position are arranged a stout, curved, dorsal spine, and laterally, a single hair and a multiple tuft. There is no pecten. Anal segment relatively long, ringed by the saddle. Gills shorter than the segment, pointed.

Present records of M. perturbans in the province are confined to the Fraser and Okanagan Valleys, but this may reflect a concentration of collecting in these areas. Where present, this is a strong flier and an aggressive biter that enters houses quite freely. Fortunately, it does not appear to be present anywhere in the province in sufficient numbers to become troublesome.

The structure and habits of the larvae and pupae of this mosquito set it apart from all others in Canada. The air tube of the larva and the respiratory trumpets of the pupa are so modified that, instead of surfacing for air, the organisms attach themselves to the underwater stems of aquatic plants, which then provide all their oxygen requirements. Hence, they remain submerged for all their pre-adult life. For this reason they are rarely seen, and are difficult to collect, as they quickly release themselves from any plant material that is disturbed. A simple method of collection is to pull the cattails quickly from the water and transfer them to a white enamel pan. Some larvae will be lost, but others will end up in the pan. Another method is to wade out to the plants and carefully insert a common dipper into the ooze beneath the roots, then scrape the roots with the dipper

and raise it carefully to the surface. When the mud has settled, the larvae may be recovered.

In the foregoing discussion, it will have been noted that several species have not yet been captured in British Columbia, although there are varying degrees of likelihood that they may yet be found to occupy some ecological niche in the province. These include Aedes hendersoni, A. melanimon, A. punctodes, Culex peus, and Culiseta minnesotae. Two other species have been collected only on single occasions, but may turn up more frequently in more extensive collecting. Other species, Anopheles walkeri Theobald, has become established in the literature on the basis of a single report, that of the 1944 Anopheline Survey. The specimen in this case was later determined by Matheson to be one of A. freeborni..

In conclusion, it should be pointed out that there are still large areas in British Columbia where the mosquito fauna has never been sampled. Fairly intensive collecting has been done in the lower Fraser Valley, the North and South Thompson Valleys, and parts of the Okanagan. There are spotty records from Vancouver Island, the Skeena Valley, the Chilcotin and Cariboo plateaus and the Kootenays. The western slopes of the Coast Range, the Queen Charlotte Islands, the whole area north of the Jasper - Prince Rupert line, west of the mountains, and much of the Kootenay country are as yet untouched.

GLOSSARY

Abdomen -	the third or posterior division of the insect body. The adult mosquito abdomen is divided into eight apparent segments. The larva has nine.
Adult -	the full-grown, sexually mature insect.
Aedine -	associated with, or pertaining to, the genus Aedes.
Air-tube -	an appendage of the eighth abdominal segment in the mosquito larva that serves for breathing purposes.
Anal gills -	appendages of the ninth or anal segment in the larva that serve to maintain correct balance of body fluids.
Anal segment -	the ninth abdominal segment in the larva.
Anopheline -	associated with the tribe Anophelini, as opposed to the Culicini.
Antenna - (pl. antennae)	paired segmented sensory organs attached to either side of the head.
Antepalmate -	hair 2 on segments of the anopheline larval abdomen (See Fig. 12).
Anterior -	in front; towards the forward aspect.
Apex -	that part of an appendage farthest away from the base or point of attachment.
Apical -	near, or pertaining to, the apex of an appendage.
Appendage -	a part or organ attached by a joint to any other main structure.
Basad -	toward the base.
Basal -	at or pertaining to the base or point of attachment.
Baso-lateral -	at the sides of the basal portion of a structure or segment.
Bifurcate -	forked into two parts.
Chitinous -	composed of chitin, a hardened secretion of the epidermis.
Clypeal -	pertaining to the clypeus.
Clypeal hairs -	prominent hairs attached to the clypeus of the anopheline larva (Fig. 11).
Clypeus -	in anopheline larvae, the sclerite forming the dorsal portion of the head.
Comb -	in culicine larvae, a cluster of spiny scales on the eighth abdominal segment, near the base of the air tube.
Constricted -	reduced in diameter for a portion of the length.
Costa -	the thickened anterior margin of the wing.

Coxa - the basal segment of a leg.

Cross-veins - short veins running between the main longitudinal veins.

Culicine - associated with the tribe Culicini, as distinct from the Anophelini.

Cuticle - the outer covering of the insect, formed mainly of chitin.

Distal - near or toward the free end of an appendage.

Dorsal - of or belonging to the upper surface.

Dorso-apical - at the apical end of the dorsal aspect.

Dorso-lateral - at the sides of the dorsal aspect.

Epidermis - the cellular layer of the skin, underlying and secreting the cuticle.

Femur(pl. - femora) the thigh, or principal segment of the leg. It is joined to the body by trochanter and coxa, and bears the tibia at the distal end.

Flagellum - that part of the antenna beyond the torus.

Frons, front - that part of the adult head between the base of the antennae and the eyes.

Frontal - pertaining to, or extending from the front.

Genus (pl. genera) a group of species having one or more characters in common.

Gills - appendages of the anal segment associated with the water-balance of the body fluids.

Head - the first, or anterior division of the insect body.

Hypostigmal spot - a cluster of few to many scales immediately beneath the anterior spiracle.

Instar - the period or stage between the molts of a larva.

Integument - the outer covering or cuticle of the body.

Larva - the second stage in the life cycle, from the hatching of the egg to the formation of the pupa.

Lateral - pertaining to the side.

Lateral hairs - in the mosquito larva, stout hairs extending laterally from most of the abdominal segments.

Latero-basal - at the sides of the basal part.

Mandibles - the first pair of jaws in an insect, modified in the adult mosquito to form piercing structures. In the larva they are toothed chewing appendages.

Marginal - at, or pertaining to, the margin or edge.

Maxillae - the second pair of jaws in an insect, highly modified for piercing in the adult mosquito, but more generalized in the larva.

Median - at, or pertaining to, the middle.

Medio-dorsal - in the central part of the dorsal aspect.

Mesepimeral - on, or pertaining to, the mesepimeron.

Mesepimeron - in the adult thorax, a sclerite immediately anterior to the posterior spiracle (Fig. 2).

Mesonotum - in mosquitoes, the upper surface of the adult thorax, also called the scutum.

Palmate - developed like the palm of a hand, with finger-like extensions.

Palp, palpus - one of the paired sensory appendages either side of the mouth-parts.

Pecten - the row of comb-like teeth on the air tube of the larva.

Penultimate - the last-but one; lying just before the apical segment.

Pigmented - darkened; coloured.

Pleuron - the lateral region of any segment of the insect body, of the thoracic segments commonly.

Plumose - feathery.

Post-clypeal - on the head of the anopheline larva, inconspicuous hairs placed postero-laterally of the clypeals (Fig. 11).

Post-coxal scale patch - a cluster of scales found on the membrane between the anterior coxa and the sternopleuron (Fig. 2).

Postero-dorsal - at the rear of the upper surface.

Postero-lateral - behind and towards the side.

Postero-medial - behind and towards the middle.

Post-spiracular - a cluster of bristles on the postero-dorsal part of the mesanepisternum (Fig. 2).

Preantennal hair - hair 7 on the larval culicine head (Fig. 4).

Precratal - anterior to the barred area on the ventro-apical aspect of the anal segment (Fig. 34).

Prescutellar area - a depressed patch on the scutum, immediately anterior to the scutellum.

Proboscis - the elongated structure containing the piercing and sucking mouthparts.

Prothoracic hairs - a group of hairs extending along the anterior edge of the first thoracic segment in the larva.

Proximal - nearest the body; opposite of distal.

Pruinose - covered with a bloom that can be rubbed off.

Pupa - the third stage in the insect life cycle, intermediate between the larva and the adult.

Saddle - the chitinous plate on the anal segment of the larva.

Scale - a flattened outgrowth of the skin, probably a modified hair; scales form the vestiture of the adult mosquito and the comb on the eighth segment of the larval abdomen.

Sclerite - any hardened part of the insect body wall bounded by sutures or membranes.

Sclerotized - hardened in a definite area.

Scutellum - a curved transverse sclerite at the posterior end of the scutum or mesonotum, and separated from it by a depressed line (Figs. 1, 2).

Scutum - in mosquitoes, the dorsal aspect of the thorax; the mesonotum (Fig. 1).

Segment - a ring or subdivision of the body or of an appendage, usually separated from adjoining ones by flexible areas.

Segmental - pertaining to a segment.

Serrated - toothed.

Seta (pl. setae) - a slender hair-like appendage.

Sinuous - recurved.

Siphon - the air-tube or breathing organ attached to the eighth abdominal segment in the larva. (Fig. 4)

Siphonal tufts - prominent hair tufts on either side of the siphon. Their position and number aid in determination (Fig. 4).

Species - a population of similar individuals usually reproductively isolated from other such populations.

Spiculate - bearing spicules.

Spicule - a minute pointed spine or process of the cuticle.

Spinose - bearing spines.

Spinule - a small spine.

Spiracle - a lateral pore or opening through which air reaches the tracheae. (Fig. 2)

Spiracular bristles - a group of bristles attached in the spiracular area, between the anterior spiracle and the posterior pronotum (Fig. 2).

Sternopleuron - the largest sclerite on the lateral aspect of the adult thorax (Fig. 2).

Sternopleural bristles - a group of long bristles on the lower half of the sternopleuron (Fig. 2).

Subapical - near, or below, the apex.

F2

Subcosta - a long vein in the wing closely parallel to costa and curving into it before the apex. (Fig. 3)

Subequal - nearly equal.

Submedian - slightly laterad of the middle line.

Suture - a seam or depressed line indicating the division between parts of the body wall.

Tarsus - the distal part of the leg, consisting of five segments, articulating with the tibia.

Tergite - a dorsal sclerite or part of a segment.

Terminal - at the tip or apex; opposed to basal.

Thorax - the second section of the insect body, bearing the wings and legs.

Tibia - that section of the leg immediately distal to the femur, and bearing the tarsi at its outer end. (Fig. 1)

Torus (pl. tori) - the enlarged, globular segment at the base of the adult antenna (Fig. 17).

Trachea (pl. tracheae) - a spirally-ringed internal air tube.

Tubercle - a little pimple, usually bearing a seta at its apex.

Vein - one of the rod-like structures that support and stiffen the wing.

Ventral - pertaining to the lower surface.

Ventral tuft - siphonal tuft.

Vertex - the top of the head, between the eyes, front, and occiput.

BIBLIOGRAPHY

1. Aitken, T.G.H. 1939 The Anopheles maculipennis complex of western North America. Pan. Pac. Ent. 15: 191-192

2. Barr, A.R. 1957 A new species of Culiseta from North America. Proc. Ent. Soc. Wash. 59:163-177

3. Bates, Marston 1949 The natural history of mosquitoes. New York, MacMillan.

4. Bierne, B.P. 1955 Collecting, preparing and preserving insects. Canada Dept. Agric. Pub. 932.

5. Breland, O.P. 1960 Restoration of the name Aedes hendersoni Cockerell, and its elevation to full specific rank. An.. Ent. Soc. Amer. 53:600-606.

6. Bristowe, W.S. 1947 The book of spiders. London, Penguin.

7. Burgess, L. 1957 Note on Aedes melanimon Dyar, a mosquito new to Canada. Can. Ent. 89:532.

8. Carpenter, S.J. & LaCasse, W.J. 1955 The mosquitoes of North America, Berkeley, Calif., U. of Calif. Press.

9. Chapman, H.C. & Barr, A.R. 1964 Aedes communis nevadensis a new subspecies of mosquito from western North America. Mosq. News. 24:439-447.

10. Chapman, H.C. & Grodhaus, G. 1963 The separation of adult females of Aedes dorsalis (Meig.) and A. melanimon Dyar in California. Calif. Vect. Views 10(8):53-56.

11. Crosby, T. 1907 Among the A-koo-me-nums or flathead tribe of Indians of the Pacific Coast. Toronto, Briggs :243.

12. Dyar, H.G. 1904 Notes on the mosquitoes of British Columbia. Proc. Ent. Soc. Wash. 6(1): 7-14.

13. _____ 1919 The westward extension of the Canadian mosquito fauna. Ins. Ins. Mens. 7:11-39.

14. _____ 1922 The mosquitoes of the United States. Proc. U.S. Nat. Mus. 61:1-119.

15. _____ 1922 The mosquitoes of Canada. Trans. Roy. Can. Inst. 13:71-120.

16. _____ 1928 The mosquitoes of the Americas. Carnegie Inst. Wash. Pub. 387.

17. Gjullin, C.M. Sailer, R.I. Stone, A. Travis, B.V. 1961 The mosquitoes of Alaska. U.S.D.A. Agric. Hdbk. No. 182.

18. Hearle, E. 1926 The mosquitoes of the lower Fraser Valley, British Columbia, and their control. Nat. Res. Council Rept. No. 17: 1-94.

19. _____ 1927 List of the mosquitoes of British Columbia. Proc. Ent. Soc. B.C. 24:11-19.

20. _____ 1932 Notes on the more important mosquitoes of Western Canada. Proc. N.J. Mosq. Ext. Assn. 19:1-8.

21. Hocking, B. 1954 Flight muscle autolysis in Aedes communis (DeGeer) Mosq. News. 14(3):121-123.

22. Hocking, B. Richards, W.R. Twinn, C.R. 1950 Observations on the bionomics of some northern mosquito species. Can. J. Res. D. 28:58-80.

23. Howard, L.O. Dyar, H.G. Knab, F. 1917 The mosquitoes of north and central America and the West Indies. Carnegie Inst. Wash. Pub. 159. 4 Vols.

24. King, W.V. Bradley, G.H. 1941 The general morphology of Anopheles and classification of the neararctic species, Amer. Assn. Adv. Sci. Pub. 15:63-70.

25. Laut, A.G. 1920 Pioneers of the Pacific Coast.

26. Lees, J.A. Clutterbuck, W.J. 1889 B.C. 1887 - A ramble in British Columbia. London, Longmans Green.

27. Lord, J.K. 1866 The Naturalist in Vancouver Island and British Columbia. Richard Bentley, London.

28. Mail, G.A. 1934 The mosquitoes of Montana. Mont. Agric. Exp. Sta. Bull. 288:1-72.

29. Matheson, R. 1944 A handbook of the mosquitoes of North America. Ithaca, N.Y. Ed. 2 Comstock: 1-314.

30. Neilson, L.T. Lineham, J.H. Rees, D.H. 1963 New distribution records for mosquitoes in the Rocky Mountain states. Proc. N.J. Mosq. Ext. Assn. 50: 424-428.

31. Price, R.D. 1958 A description of the larva and pupa of Culiseta (Culicella) minnesotae. J. Kans. Ent. Soc. 31:47-53.

32. Rempel, J.G. 1950 A guide to the mosquito larvae of Western Canada. Can. J. Res. D. 28:207-248.

33. _____ 1953 The mosquitoes of Saskatchewan. Can. J. Zool. 31:433-509.

34. Roseboom, L.E. 1952 Anopheles earlei Vargas 1943 in Montana. Identity and adaptation to laboratory conditions. Amer. J. Trop. Med. & Hyg. 1(3):477-483.

35. Stage, H.H. Gjullin, C.M. Yates, W.W. 1952 The mosquitoes of the northwestern states. U.S.D.A. Agric. Hdbk. 46:1-95.

36. Theobald, F.V. 1910 Monograph of the Culicidae or mosquitoes. Lond, Brit. Mus. N.H. 5 vols.

37. Twinn, C.R. 1944 Report of the 1944 Anopheline mosquito survey in Canada. Can. Dept. Agric. Div. Ent. Proc. Pub. 17.

38. Vockeroth, J.R. 1952 The specific status of Aedes pionips Dyar. Can. Ent. 84(8):243-247.

39. _____ 1954 Notes on the northern species of Aedes with descriptions of two new species. Can. Ent. 86(4):109-116.

40. _____ 1954 Notes on the identities and distribution of Aedes species, with a key to the females. Can. Ent. 86(6):241-255.

41. Wesenberg-Lund, C 1921 Contribution to the biology of the Danish Culicidae. Copenhagen, A. F. Horst & Son. 210 pp.

OCCASIONAL PAPERS SERIES

of the

BRITISH COLUMBIA PROVINCIAL MUSEUM
VICTORIA, B.C.

No. 1. The Vertebrate Fauna of the Peace River District of British Columbia. I. McT. Cowan. 1939. (Out of print.)

No. 2. Oceanic Fishes from the Northeast Pacific Ocean. Wilbert McLeod Chapman. 1940. (Out of print.)

No. 3. The Grebes: Studies of Waterfowl in British Columbia. J. A. Munro. 1941. (Out of print.)

No. 4. Some Accounts of the Flora and Fauna of the Driftwood Valley Region of North Central British Columbia. John F. and Theodora C. Stanwell-Fletcher. 1943. (Out of print.)

No. 5. A Corner Stone of Canadian Culture: An Outline of the Arts and Crafts of the Indian Tribes of British Columbia. Alice Ravenhill. 1944. (Out of print.)

No. 6. Observations of Birds and Mammals in Central British Columbia. J. A. Munro. 1947. (Out of print.)

No. 7. The Birds of the East Kootenay, British Columbia. Walter B. Johnstone. 1949. (Out of print.)

No. 8. The Birds and Mammals of the Creston Region, British Columbia. J. A. Munro. 1950. (Out of print.)

No. 9. A Natural History Survey of the Manning Park Area, British Columbia. G. Clifford Carl, C. J. Guiguet, and George A. Hardy. 1952. (Out of print.)

No. 10. An Ecological Study of Goose Island, British Columbia, with Special Reference to Mammals and Birds. C. J. Guiguet. 1953. (Out of print.)

No. 11. The European Starling in British Columbia: 1947–1957. M. T. Myres. 1958. 75 cents.

No. 12. A Catalogue of British Columbia Sea-bird Colonies. R. H. Drent and C. J. Guiguet. 1961. (Out of print.)

No. 13. The Breeding Ecology of the Glaucous-winged Gull (*Larus glaucescens*) on Mandarte Island, British Columbia. Kees Vermeer. 1963. 75 cents.

No. 14. The Evolution of the Mammals of the Queen Charlotte Islands, British Columbia. Bristol Foster. 1965. $1.

No. 15. The Mosquitoes of British Columbia. L. Colin Curtis. 1967. $1.

Other publications of the Provincial Museum are:—

Annual Reports: Covering the activities of the Museum for each year.

Handbook Series: Contributions concerning the natural history of the Province.

Anthropology in British Columbia Series: Reporting on activities in the field of anthropology for each year.

Special Publications: Containing material not included in other series.

These may be obtained by applying to the British Columbia Provincial Museum, Victoria, B.C.